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CULTURAL GAMES AND MATHEMATICS TEACHING: A STUDY OF TEACHERS IN BOTSWANA

by

KGOMOTSO GERTRUDE GAREGAE-GAREKWE ©

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF EDUCATION

DEPARTMENT OF SECONDARY EDUCATION

EDMONTON, ALBERTA
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Thomas E Kieren
Dr. Thomas Kieren *(Supervisor)*

Dr. Sol Sigurdson

KJ Willson
Dr. Katherine Willson

Date 21 Sept /94

DEDICATION

TO MY HUSBAND DUNCAN LEINANYANA

MY SON TSHEPHO BONOLO

AND

MY DAUGHTER MAIPELO AMANTLE MALEBOGO

ABSTRACT

The purpose of this study was to find the extent to which Primary School teachers incorporate traditional or cultural games in the teaching of mathematics, and how they carry out such an integrated instruction.

Five research questions directed the inquiry. A questionnaire and an interview schedule were used to gather data. Two hundred standard 2 and 3 primary teachers in the Central District, Botswana, were invited to participate in the study. A total of 145 teachers responded, 10 of which were interviewed.

The results of the study showed that teachers had little experience in using cultural games in mathematics teaching. However, teachers showed an interest in integrating traditional games in their teaching; if they could be given written guidance as to how they could do this they would greatly appreciate it. Furthermore, teachers have shown that they are aware of the usefulness of using cultural games in their teaching. They use these games to teach other subjects such as social studies, Setswana and English.

Teachers have indicated the topics in which they integrate traditional games and their modes of use. Geometry was indicated as one of the most common concepts embedded in mhele game. There were no relationships between the use of cultural games and: (a) teachers' years of experience, and (b) teachers' academic qualification.

The results of this study were regarded as the basis for further study.

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CHAPTER I

INTRODUCTION

This chapter discusses briefly the education system in Botswana as background information to the problem; it also identifies the problem, explains the purpose, and shows the significance of the study. Included also are the limitations and the delimitation of the study, basic assumptions, and definitions of terms.

Botswana Education System

The educational system in Botswana comprises seven years of primary schooling, two years of junior secondary, and three years of senior secondary (7-2-3). This is a transition towards a 6-3-3 structure by 1995 (Evans & Yonder, 1991). The 7-2-3 structure was recommended by the first National Commission on Education in 1977 in order that the government might achieve Universal Nine-Year Basic Education (Republic of Botswana, 1977a).

The administration of primary education is undertaken by two ministries: the Ministry of Education (MOE), which determines the curricula and provides and supervises teachers; and the Ministry of Local Government and Lands (MLGL), which provides school buildings and equipment through financial support to districts and councils.

The primary schools fall under three categories: the local government schools (93%) which are run by council committee; the government aided schools (5%) which are run mostly by non government organizations but receive some grants from the government to support special programs; and private schools (2%), which do not receive any financial help from the government.

Whereas private schools use English as the medium of instruction from standard one, government schools use Setswana, the local language for the first four grades (standard one to four); thereafter, English is used as the language of instruction as well.

The minimum entry age is six years and the maximum is nine. Children go through standard one to four automatically by promotion from one grade to the next annually. In standard four they write attainment tests in mathematics and Setswana. Children who do not pass these tests may be allowed to repeat the grade. The Primary School Leaving Examinations (PSLE), which are taken at the end of the seventh year, mark the end of primary education. The results of these examinations are used as a screening filter for junior secondary level.

Generally, better facilities and qualified teachers are found more often in urban areas and big villages than in remote rural areas. Thus, the PSLE results are better in urban areas and big villages than in remote areas. Consequently, students from these places have a better chance of secondary education than those from remote rural areas. However, this problem will be eliminated when the government succeeds in having enough intermediate schools, called Community Junior Secondary schools, for all standard seven leavers, thereby achieving the Universal Nine-Year Basic Education.

Primary education curricula comprises of mathematics, Setswana, English, social studies, agriculture and religious education (Curriculum Unit, Republic of Botswana, 1992).

Education Developments after Independence

A few years after her independence (from British Protectorate in 1966), Botswana perceived the need to reassess her education system. Thus in 1975 the first National Commission on Education (NCE) was entrusted with the task of reviewing the then current education system (Republic of Botswana, 1977a). The Commission's task aimed at making the curriculum relevant to the needs of the learners and to the country's development. The problems identified were that:

> The schools are too separated from the world of work. There are not enough opportunities to combine study and work, and the syllabuses and the curricula are too academic. Children are not taught about the real, practical world (Republic of Botswana, 1977b, p. 2).

At the time of independence there was a shortage of skilled manpower, and thus "the priority was for quite sometime placed on secondary and higher education" (Kann, Mapolelo, & Nyela, 1990, p. 79). Thus the commission recommended that the education strategy should change. Consequently, much emphasis was put on primary education mainly because they saw it as the basis for further education. This was stated explicitly in the subsequent National Development Plan 1979-85 (NDP):

> Government attaches the highest priority within education to the primary education sector. First, in the interests of equality of opportunity and of developing the potential of all children, the Government seeks to provide universal access to primary education. Secondly, *since primary education lays the foundation for further education and training and for productive employment,* the Government seeks to improve its quality and relevance ([emphasis added] (Republic of Botswana, 1979. p. 107).

Through the implementation of the recommendations of the Commission, primary education has experienced rapid expansion and development. Whereas in 1976 there were 335 schools with a total enrollment of 126, 000; in 1988 there were 568 schools and an estimated enrollment of 248, 823 (Republic of Botswana, 1987a).

There were also qualitative improvements. Measures were taken to improve teachers' conditions, administration, and instruction. More in-service work was done through workshops, conferences, and short courses. The Commission had emphasized the need for expansion in supervisory service because it believed that good supervision ensured the quality of instruction:

> Primary education has continued to place emphasis on the orientation of the supervisory behavior system. A program of ongoing training

> for headteachers has, as its major goal, ***influencing the instructional changes in the classroom, which will hopefully affect the pupils' learning behavior system.*** Clinical supervision are considered highly desirable skills in an instructional supervisory behavior system [emphasis added] (Republic of Botswana 1987a, p. 7).

The Commission suggested this emphasis because they found that most of the teachers were untrained and that courses offered in Teachers Training Colleges (TTC) were unsatisfactory. Botswana Teaching Competencies Instruments (BTCI) were developed for this reason. (Teachers' courses will be discussed in greater detail in chapter 4.)

Primary Curriculum Innovations

In any education system, either the weakness or the strength of the lower level affects the subsequent levels. In Botswana, the survey carried out in 1976 showed that the primary school leavers were lacking in numeracy and literacy skills, the effects of which were reflected in secondary school performance (Evans, Heseley, & Leep, 1986). This problem was attributed mainly to the lack of teaching facilities (no chalkboard, no textbooks, and so on), and low qualification of teachers. To alleviate the situation, plans were made to upgrade qualifications of teachers and administrators.

The Primary Education Improvement Project (PEIP), funded by The Governments of Botswana and the United States Agency for International Development (USAID), was launched in 1981 to improve the quality of teachers through in-service and pre-service programs. The latter included diploma and degree programs at the University of Botswana, then called the University College of Botswana (UCB). The Diploma in Primary Education (DPE) course takes two years and the Bachelor of (Primary) Education (B. Ed. Primary) takes four years.

For in-service programs, BTCIs were developed from 1983 through 1985. They "were the first step in upgrading the supervisory roles and responsibilities of the headteachers and educational officers" in Botswana education system (Evans, 1985).

BTCIs help in measuring teaching skills or competencies which, in turn, help supervisors to know what teachers are doing well and where they need help to develop more skills and better teaching competencies. The headmasters and the education officers were to study the instruments, then help teachers to improve their classroom practices and skills, and that is the way we can improve the quality of education.

In order to improve the quality of teaching, the Breakthrough and Project approaches were introduced as innovations in the instructional methods. These approaches are child-centered. For example, the project method makes the child feel more united with real life situations because it starts with the children's experience (Jones, Leeke, Leeke, & Tarpey 1983a). Other innovations in primary education included Guidance and Counseling programs, and Special Education programs.

The Project Method. The Project Method departs from the traditional style of teaching, which dismisses the learners' curiosity. Instead, the method entertains the nature of children's curiosity and the struggle for answers through active involvement. The approach values and acknowledges that which children learn from their experiences before coming to school (Jones et. al., 1983a). It is a child-centered learning-activity approach to teaching which begins with the child's interest and is carried on both within and outside the classroom (Horgan, Moss, Kesupile, Maphorisa, and Haseley 1991, p. 84). Children's learning is integrated in group or individual projects.

Jones, Leeke, Leeke, and Tarpey (1983b) argued that the project topics must come from the children's environment as a stimulus for learning: the home, the family, the culture and the everyday occurrences which interest the child. The duty of the teacher is only to encourage and guide learners in their own investigations.

Some of the aims and objectives of the project approach include to develop learning built on children's interest and experience, to maintain children's natural curiosity, to encourage children's abilities in communication, to develop skills and attitudes crucial to good learning, to develop the kind of general knowledge which will allow the child to see himself as part of the society, and to foster the children's appreciation of their own and other cultures (Jones et al., 1983b).

Even though the results of the Project Method were desirable, some problems were encountered during its implementation, among which were: time constraints and difficulties in planning to reflect the child's point of view; inexperience of teachers, which led to failure to divide effectively the time between the projects and the teaching of core subjects and basic skills; and impracticable time tabling of children's projects in the already tight school day schedule (Horgan et al., 1991). The Project Method themes come from the areas of health and social studies.

The Breakthrough to Setswana Approach. Breakthrough to Setswana is an innovation introduced in 1983 to teach the local language, Setswana, to standard one classes. It is a highly student-centered approach with much active learning. Learners participate in their learning by constructing knowledge; approving what seems to integrate well in their existing schemes of knowledge and disapproving of what does not fit well. The method aims at teaching children to read fluently and write with confidence from the beginning of their schooling.

The method alters the traditional roles of both the teachers and the learners; learners no longer rely on being told what to do, and work out sentences for themselves; they are self-disciplined, working at their own pace; the mode of learning shifts from rote repetition to meaningful understanding. Teachers encourage and guide the learners in their activities.

The course is divided into three sections called stages. In stage one children are divided into four groups each of which is introduced to a teacher's sentence-maker card and they gradually learn the first set of core-vocabulary words (ISEA, 1985). The three other groups that are not with the teacher are occupied with other work such as drawing pictures and practicing letter patterns. At the end of this stage an individual child is tested on the vocabulary learned. The information is used for stage two selection where children are put into four ability groups.

In stage two, the children make sentences using their own sentence-makers and they learn the rest of the vocabulary. This stage takes more time and children have to master reading and writing vocabulary common to their experiences (Horgan et el., 1991). By the end of this stage the sentence-makers are full, and the children are able to read *Breakthrough* readers and are ready for stage three.

In stage three the emphasis is on written and oral communication, because with good communication skills children can read and write fluently. By the end of this stage, children read and write fluently in their mother tongue; they have 'broken through' to literacy (ISEA, 1985, p. 19).

When using either the Project Method or the Breakthrough Method "the teacher creates a democratic environment under which pupils work independently as individuals and in groups sharing ideas as much as possible to solve problems. ... The democratic learning situation motivates the individual; ..., pupils begin to open up and feel confident in doing things on their own with little dependence on the teacher" (Jones et al., 1983a, p. 1).

None of these interactive methods of instruction (Breakthrough or the Project Method) is used in mathematics teaching, but in the same manner the introduction of cultural games in the teaching of mathematics could provide a child-centered approach with much interactive learning. This would allow children's background and interests to be integrated into the curriculum, and thus classrooms might be filled with meaningful activities for the learners. Like the Breakthrough and Project Method approaches, using the cultural games could allow the learners to share their ideas with the teacher and amongst themselves. This may, among other things, bring some improvement in the learners' communication skills, both oral and written.

Identification of the Problem

Mathematics is unique amongst the school subjects in its adherence to symbol, pattern and precision. This description implies special considerations of the growth of the subject in relation to child development and intellectual functioning.

Piaget's theory claims that an individual child develops and learns as she or he acts in an environment. This would suggest that the intelligence and general knowledge are manifested in the context of manual and mental actions through interactive and creative processes. Play activities in which children engage at home are no exception. They can form a basis for mathematics learning and can be transformed to foster learning.

Children grow up playing with various objects, sometimes mimicking adults, and they enjoy doing so. As the years pass they engage in games with rules (Piaget, 1972); but as they go to school, some teachers, if not all, de-emphasize play to the extent of separating it from work (Aoki, 1990). This may result either in diminishing pupils' interest in school activities or labeling play as an unimportant activity, though it is, in fact, essential for the development of every growing child. Yardley (1988) argued that children are motivated by their own desires, and if the situation does not satisfy their curiosity learning becomes passive, not personal. Van Hoorn , Scales, and Alward (1993) support the above argument:

> In constructivist view, knowledge is not simply acquired by accumulating information from the environment, or even copying the behavior of others, but is based on what the individual child brings to each situation. The 'schemes' or mental patterns that the child has already constructed are modified and built upon as children try to make sense of new experiences in the light of what they already know (p. 15).

Some studies (Klann 1980; Little, 1990; Teasdale, 1990; Turner, 1989) have shown that through the use of games and cultural activities in classroom instruction, curricula can be made relevant to the needs of the learners and provide appropriate learning levels, thus increasing motivation and active participation of all learners. Cultural games and activities can develop positive self-concepts in the learners and also raise school achievement (Turner, 1989). These attributes are needed in mathematics education as well.

If such games are to play a more important role in the mathematics curriculum, it is important to find out if and how games are currently used, and the context and nature of teachers' familiarity with them. **Therefore, this study seeks to find out the extent to which Botswana teachers of lower primary school levels use cultural games to arouse learners' curiosity and interest, and encourage active participation from the learners' point of view**. In particular, the study seeks to determine the degree to which teachers integrate cultural games in their classroom teaching and how they carry out the integrated instruction.

The Purpose of the Study

Teachers are identified as critical components in curriculum planning, decision making, and implementation (Brauer, 1981). They interpret the intended goals of the curriculum into operational classroom objectives. As their day-to-day duty they select, adapt, and develop objectives, content, and resources for their teaching and learning situations. Their skills, knowledge of the subject, and attitudes influence the kind of teaching which takes place in each classroom. Behind closed classroom doors teachers determine the quality of learners' experiences.

Because teachers are responsible for any innovation in the school and are well conversant with issues and problems pertaining to the classroom situation, their awareness of activities which interest and motivate students is vital. Thus, the purpose of this study is to find the extent to which primary school teachers incorporate cultural games in which young children get involved before coming to school and in the teaching of mathematics, and how they use these games. The study seeks to find out if teachers are aware of the usefulness of children's background knowledge that they have acquired through interaction with their social environment such as cultural games, rhythms, and play songs. Specifically, the study seeks to answer the following questions:

1. a. Are primary school teachers using games in their teaching?
   and
   b. To what extent do standard two and three teachers use cultural games in the teaching of mathematics?
2. a. In which mathematics topics do teachers use cultural games?
   and
   b. For what purposes are the games used in each of the topics?
3. a. What mathematical concepts do teachers 'see' in cultural games?
   b. How do teachers make learners use these ideas in the teaching and learning of school mathematics?
4. What applications do teachers 'see' in a specific game, 'mhele'?
   a. What mathematical concepts are displayed in the mhele diagram?
   b. What skills are learned in playing the game which are useful in mathematics learning?
   and
   c. How can the game be modified to suit the teacher's needs?
5. Is there any relationship between:
   a. the respondent's years of teaching experience and the use of cultural games in the teaching of mathematics?
   b. the respondent's qualifications and the use of cultural games in the teaching of mathematics?

Although the interview schedule was used to augment data collected through the use of the questionnaire, it focused on the third research question. It is through the discussions with teachers that one could get the essence of what really happened during classroom teaching.

The Significance of the Study

Students' performance in any subject depends upon their attitudes towards that subject. Mathematics is not an exception. Students do well in mathematics if they have positive attitudes toward mathematics. In like manner they might perform badly if they have negative attitudes towards the subject. "Once attitudes have been formed they become persistent and difficult to change" (Cockroft, 1982, p. 101). As a result negative attitudes towards mathematics inhibit future learning of the subject.

The literature (Cockroft, 1982; Charles & Lester 1989) showed that by the time students finish their primary education, their attitudes towards mathematics (or any other subject) have become relatively fixed. As a result, their subsequent performance in secondary education is affected by such attitudes. These attitudes towards mathematics build up through experiences that children encounter in the classrooms. The literature cites two areas of concern on this issue: the content and the way the material is presented (Charles & Lester, 1982).

Charles and Lester (1982) asserted that the majority of students dislike mathematics by the time they complete elementary schooling because of over emphasis on drill and practice. They argue that children are never given an opportunity to get involved in real world applications and problem solving; children are rarely fully engaged in learning of mathematics, and as a result the subject becomes boring, and children ultimately become indifferent to it.

Once children fail to see the relevance of a subject to their everyday needs, they feel no need to study such a subject. This happens when the content is taught in an abstract manner-- not in a concrete way. "Children cannot be expected to be able to make sense of their mathematics in everyday situations unless they have opportunity to experience these situations themselves" (Cockroft, 1982, p. 86).

According to Piaget (cited in Thomas, 1991) children at primary school are still at a concrete operational stage (6 to 12 years). At this particular stage they learn more when they handle or manipulate and see the objects. Moreover, children in all stages of attainment benefit when they are exposed to appropriate practical experiences. Practice help students to consolidate the already attained skills and also to practice recently acquired skills. Therefore, using children's background knowledge such as cultural games may help to make the teaching and the learning of mathematics meaningful to them.

According to Turner (1989), Teasdale (1990), and Little (1990), cultural activities such as games and play songs when incorporated in classroom settings not only motivate the learners but also provide them with a relevant curriculum in terms of content and appropriate development level. The classroom atmosphere becomes relaxed, providing more interaction among the learners themselves, and between them and their teacher. Speaking about the advantages of using games in the classroom Ernest (1986) commented:

> Pupils become strongly motivated, they immerse themselves in the activity, and over a period of time should enhance their attitude towards the subject. In addition to being motivating in themselves, games also add variety to the overall mathematics curriculum, by bringing another varied approach into the teaching of the student. (p. 2)

As children grow, they are exposed to games in the society, and they create new games that reward their curiosity (Opie & Opie, 1969; Sutton-Smith, 1972). They build their own environment and learn from it as they interact with it. The interest in learning comes from internal, not from external inspiration; and thus education obtained in this manner is purposeful to children. One way of achieving such education could be through incorporating the children's backgrounds into the mathematics classroom activities; thus the importance of this study.

Gonzalo (1991) suggested that incorporating of the learners' background knowledge in the classroom helps them to develop self-esteem, as aspects or activities from their home life are recreated in the classroom. When cultural games are used in mathematics teaching, it is possible that children will not only be motivated but will also see the connection between their informal mathematics and the school-taught mathematics.

The results of this study may contribute to educational reform and improvement in two ways. First, the results may provide an agenda for teacher education reform, for both pre-service and in-service training. This would reawaken teachers' awareness of the pedagogical importance of games, so that mathematics may be more intelligible and interesting to their students.

Tobias (1991) argued that factors that hinder mathematics learning such as mathematics anxiety can be cured, "but it involves changing learners' *and teachers' attitudes at the same time*" (p. 91) [emphasis added]. Therefore teachers must be willing to revisit their style of teaching and also to accept more pressure on their already tight schedule. They must be willing to bring to their classes activities that will motivate and interest their learners, thus cultivating positive attitudes towards the learning of mathematics in the future. Negative attitudes towards any subject should be prevented from developing as early as primary education, hence the importance of this study.

Second, the results could be used as a reinforcement to both the Breakthrough and the Project methods. Both methods are child-centered and encourage activity-based learning. In the case of the Project approach the main goal is to engage children's minds in ways that deepen their understanding of their own experiences and environment (Katz & Chard, 1989). Children's minds are cultivated as they plan and pose questions about their projects. Topics for the projects are taken from children's familiar surroundings and home situations.

As a way of learning, the Project approach emphasizes the children's active participation in their learning. Likewise, when cultural games are used in the classroom, student participation is expected because students are familiar with these games. The topic for the project may be one of the games they know. The game may be chosen and children asked to suggest mathematics topics which could be enhanced by the game or vice versa.

Using cultural games in mathematics teaching, just like the Project Approach, could help: to maintain children's curiosity, to encourage children to communicate with each other, to develop skills and attitudes crucial to good learning; to develop the kind of general knowledge that will allow the children to see themselves as part of the society, and to appreciate their culture as a source of mathematical knowledge.

In addition, using cultural games in the teaching of mathematics would be one of many ways of using the learners' background knowledge and interest in the classroom situation.

Basic Assumptions

1. The primary syllabuses suggest that teachers relate the mathematics concept to the learner's cultural experiences, and it was thus assumed that primary school teachers are incorporating games and play songs with which children are familiar with in the teaching of mathematics.

2. It was assumed that participants know the games that were listed in the data-collection instrument.

Delimitation of the Study

1. The study focuses on elementary teachers of children in standard two and three (with ages ranging from 8 to 10).

2) The study is delimited to one district, the Central District, because it was near the researcher's base. It includes semi-urban and rural areas with a total of about 209 primary schools, out of which twelve are private schools. The district therefore represents semi-urban, rural, and remote rural schools--the three types of schools found in the country.

Limitations of the Study

1. In addition to interviews being conducted on a small sample, the study relied on a questionnaire survey, a method which may not be able to solicit all the information which might be useful in answering the research questions.

2. By relying on teachers' self-report on the uses of games, the study cannot escape biases in their reporting.

3. The study was conducted within a very short time and also during the busy school season; therefore, there was no time for follow-up where necessary.

Definition of terms

Primary School - an institution for grades one to seven in Botswana

Standards 2 and 3 - the second and the third grades in elementary education in Botswana

Nine Year Mathematics Syllabus - a list of mathematics topics of all the first nine years of Basic Education (Republic of Botswana, 1985).

Base cultural pastures - the beliefs and the norms of the society to which the learner belongs - the nurturing milieu of the learner (Little, 1990).

Cultural games - traditional games derived from the society, not commercial games. The two words, *cultural* and *traditional*, will be used interchangeably in this thesis.

Mathematics Curriculum - the mathematics course of study

Mhele - the name of one of the traditional games

Pedagogy - the way the teacher sees the child: the total existence of the child, the child's development, her/his limits and potential (Max Van Manen, 1986).

Culture - the total sum of the attainments and learned behavior patterns of any specific period, race, or people regarded as expressing a traditional way of life subject to gradual but continuous modification by succeeding generations (Ukele, 1986).

Games - activities which simulate real situations and which may teach skills of some sort and attitudes. They are systematic and can be repeated somewhere (Klann, 1980).

Play - what a person does when she or he is free to do whatever she or he wants. It is a spontaneous expression of the inner self. It is the type of behavior engaged for fun's sake, or for pleasure of action without thought of consequences (Ellis, 1973). In this study the term will refer to being involved in activities which bring about amusement but which contribute to the education of the child.

Outline of the Thesis

Chapter I introduces the problem; delineates five research questions; defines the terms used; and outlines the underlying assumptions, delimitations, and limitations. Chapter II reviews the literature related to the study. Chapter III describes the design of the study; the selection of the participants in the study, and the data-collection procedures that were used. Chapter IV presents an analysis and discussion of the findings related to the research questions. Chapter V provides the summary of the results, conclusions, implications and recommendations.

CHAPTER II

LITERATURE REVIEW

The purpose of the literature review was to discover the advantages and disadvantages of integrating games in education, especially the cultural ones, and how teachers view this kind of instruction. This chapter therefore reviews the literature on teachers' attitudes towards curriculum change, the theories of play and child development, and the use of games (in general) in the teaching of mathematics.

Curriculum Change and Teachers' Attitudes

The attitude of the teacher plays a major role in the preparation of the lesson and hence in the occasions for children's knowledge-building attitudes. A change in teachers' beliefs about learning and the teaching of mathematics leads to specific changes in classroom practices, which in turn may result in improved student learning. However, significant changes in teachers' beliefs and attitudes are likely to take place also after changes in students' learning are experienced by teachers (Baroody & Ginsburg 1990).

Commenting on the attitudes of teachers towards the overall curriculum, Shaw et al., (1991) argued that teachers must first desire to make changes within their own classrooms before a worthwhile change can occur in the entire curriculum. These authors implied that change is local because it depends upon the individual teacher and his or her cultural environment, as well as support, time, money, resources, taboos, customs, and common beliefs. Teachers' practices may change if they have their own vision of the mathematics teaching and learning situation in their classrooms. This vision could result from self-reflection.

As teachers diagnostically study their classroom practices, they may see the need to change and thus commit themselves to observing and changing something about the situation (Schon, 1983). On the other hand, if teachers believe that the traditional style or their current style of teaching is effective, they would not entertain the idea of alternative methods.

Dewey (1933) argued that teachers must constantly be aware of learning theories that could shape their teaching styles. In order that good teaching and learning take place, teachers have to use their knowledge of theories of learning. They must build up environments conducive to active participation where children are able to ask questions and to explore and construct their own knowledge; and where interpersonal relationships, motivation, meaningful curriculum material, and conducive environments are provided (Gallagher, 1971). In this way children's curiosity and emotional needs may be met.

Even though teachers may be aware that there is an aspect of mathematics in any situation, and that children learn through understanding when they meet the need for mathematics in everyday situations, teachers are rarely allowed time and help to evaluate newer ways of working in their own practice (Yardley, 1989).

Introducing cultural games in mathematics teaching may be a great challenge to teachers because they would have to put more effort in their preparations. This kind of challenge may be viewed on the other hand, as a tool which makes teachers' work interesting and professionally satisfactory (Katz and Chard 1989).

Games in Education

Historical Background

Children's play already has been noted to have educative functions (Taylor, 1969). Plato was perhaps the first to write about the practical value of play (Millar, 1968). This was evidenced in the ways he thought to distribute apples among boys and girls and connected this to the arithmetic problems, or in the way he gave miniature builders' tools to little boys to practice building. Aristotle is also noted to have encouraged children to play and mimic adults, for he believed that by so doing children are learning adulthood activities.

Millar (1968) reported that during the seventeenth century and the early eighteenth century, educational reformers such as Comenius, Rousseau, Pestalozzi, and Froebel encouraged the teachers to incorporate the children's background in their teaching, and also to accept the idea that education should take into consideration the children's stages of development. Later, Froebel stressed the importance of play in the learning and thought that the kind of play children enjoy can be used to gain their attention and to develop their capacities and knowledge. However, there were no theories on child development then, and his ideas, though of practical value, were not used then.

Nevertheless, several studies influenced by Froebel's ideas were conducted based on the relationship between human beings and animals. Young animals' play motives were studied, and the results were inferred to human behavior (Millar, 1968). For example, a baby was thought to enjoy playing in the water because of its fishy ancestor's joy in the sea (recapitulation theory). Another theory by Groos (cited in Millar) is that play is vital for natural selection (instinct theory)--animals play because such an activity is useful for their survival--and that play practices perfect the skill needed in adult life. In the same manner the human infant continuously moves its head, fingers, and toes and learns to control its body.

Millar (1968) also cited Spencer in his argument that children play because they have a surplus energy. The explanation was that because energy is produced at a constant rate, it piles up when it is not used, but the excess must be expended. The expenditure occurs through the overt behavior called play (Ellis 1973). Parents may be convinced that the surplus energy theory is true based on the experiences and observations of their children at home. A hungry child may not get involved in a vigorous play activity, but the one who is satisfied does jump up and down as though there is a lot of energy to be expended. However, the theory fails to account for many situations in which play occurs

(Sponseller, 1974). For instance, a sick child (with less energy) may play with her doll in bed.

The instinct theory too involves some common sense. Children actively involve themselves in play to prepare for the future. Here the content of play is now determined by what a mature adult does. For example, in Botswana boys use clay and mud to make cattle. They then span these cattle to plough or pull a wagon, an activity that men undertake. Girls simulate women's role. This kind of play is called *mantlwane*.

These theories have not provided enough reasons on why children play in all situations. However, the instinct theory sheds some light on the content of play in some situations. Zaslavsky (1982), Sutton-Smith (1972), and Opie and Opie (1969) have noted that games in any society entail a form of training of the young generation. Some games in each society prepare young ones for present and future challenges of life. That is why children are able to count the number of cattle, measure the volume of whole grains, measure distances, and compare quantities using their informal knowledge of numbers (Zaslavsky, 1979)

Theories of Play and Child Development

Play and imitation are integral parts of the development of intelligence; play is observed to develop through the same stages as intelligence. Piaget's theory (1972) of play is closely related to his account of intelligence. From birth to 18 months the child is in the sensory-motor period. The child starts with uncoordinated impressions and gradually achieves the sense and motor coordinations and adjustments necessary to perceive and manipulate objects. Play starts even at this stage. The child enjoys handling the objects and may try to move them up and down. Once the child is able to make such movements, he or she may repeat the action for pleasure; by so doing, the child is playing.

The second stage of development is the pre-operational stage (two to seven years), and here the child can envisage objects in their absence through symbolic representation. The child can neither reason logically, at least in the adult sense, nor perform operations backwards. In this stage the child is involved in make-believe or symbolic play. They represent the behaviors or experiences they have seen or experienced before by objects. For instance, children may use tree leaves to represent tea utensils such as tea pot, cups and saucers, and use soil to represent tea. All these activities involved in making tea are enacted symbolically--believing that they existed.

In the third stage, from seven to twelve years, the child can reverse operations mentally and is capable of abstracting these operations from concrete instances. At this stage the child is capable of engaging in play which is more abstract and distancing; for example, games with rules.

Practice play develops the child's sensory motor domain during the first two year period, whereas symbolic play develops the representational thinking of children in the range of two to seven years of age. It also assimilates and consolidates the child's emotional experiences.

The modern theories of play are derived from the field of analytic psychology and from Piagetian theories of child development (Sponseller, 1974). Psychoanalytic theory looks at play as an activity which gives children a chance to express and master their environment. Children sometimes simulate adult roles in their make-believe games which helps them to cope with reality in the future. Both the painful and the positive situations of life can be dramatized in children's play.

Piagetian theory claims that an individual abstracts information from the outside world and tries to fit that information within the organizing schemes representing what he or she already knows (Athey, 1974). The organizations are modified if they do not fit adequately with the individual's existing knowledge. The former process is called assimilation, and the latter is accommodation. These two processes play a major role in the individual's intellectual development (Piaget, 1972).

According to Piaget these two processes also constitute play. During play the children take the outside world and manipulate it so that it fits their organization schemes. In a way, the function of play is to develop the children's intelligence.

Piaget's notion of play involves common sense to some extent because it agrees with what studies conducted by anthropologists about games of different cultures suggest. Studies conducted by Opie and Opie (1969), Zaslavsky (1973; 1982), and Sutton-Smith (1972) showed that games played in every society are the indicators of what that society values. The function of games in these societies is to train growing children into adulthood activities.

In societies where there is a need to measure, count, compare, order, sort, or weigh, children's games possess characteristics such as weighing, measuring, comparing, sorting, ordering, and counting (Zaslavsky, 1982; 1973). This was also observed by Thompson (1994) who argued that children come to school already knowing how to measure, weigh, count, sort, and order, before they are introduced to formal education.

Carpenter, Ansel, Fennema, and Weisbeck (1993) further noted that even after formal schooling children (and adults) use their idiosyncratic methods of problem solving. They model word problems before they could solve them--a practice that is familiar in counting games.

The great challenge for teachers, therefore, is using teaching methods which are related to the way children get their informal knowledge. They should help children to make connections between their informal understandings and the symbols and procedures they meet at school (Thompson, 1994). One way teachers can achieve making connections between informal and formal mathematics is by using traditional games in mathematics instruction.

According to Dewey (1933), there is a meaning in play because when children play 'store' for instance, a collection of concepts is defined and built up. As a result meanings are arranged in groups and are made to cohere in connected ways. Playing store or office shows the children's interest in numbers; it also reflects their life in a number-literate environment (Van Hoorn et al., 1993).

Play activities develop the social as well as the affective domains of the child. Monighan-Nourot et al (1987) have found that games promote the child's cognitive development. The child learns problem-solving skills and critical-thinking skills as she or plays. This means that play or games provide the child with a holistic kind of education which can be summarized as using three Hs. These are **Head** (mind, cognition), **Hands** (active participation, involvement), and **Heart** (socialization, attitudes, affection). This is pictorially represented below.

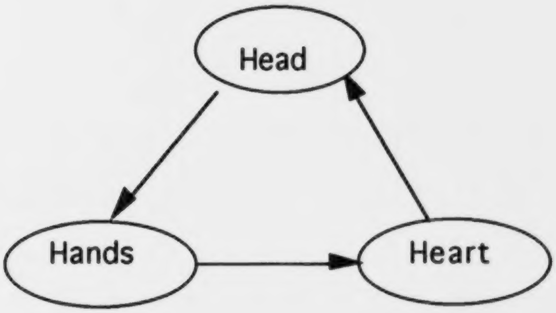


Figure 1. A Holistic Approach to Education Provided by the Games

The three aspects are inseparable. During play children are involved intellectually, physically, and emotionally. They think about what they are doing and manipulate the objects, and for play to continue, there must be some form of enjoyment.

Anthropology's Account of Play and Cognitive Development

Zaslavsky (1973) argued that before the introduction of formal schooling by Europeans, African children learned all they needed to lead a life in the tradition of their ancestors. This knowledge was transferred to them by their parents, old people, and their elder brothers and sisters. She further asserted that games form an integral part of children's education and that it is through play that children learn to live within a particular milieu.

Games have various functions in various societies. In a simple culture, physical-skill games are emphasized. In cultures that range from simple to complex, games of chance and of physical skill are played. Games of strategies are played in societies of higher level of cultural complexity (Avedon & Sutton-Smith, 1971). Games that require strength and endurance, dexterity and intellectual ability are functional in a society that depends upon these qualities in its members regardless of gender.

Because they are expressions of cultural values, games are integrally related to cultural institutions such as religion, social activities and child-rearing customs (Ager 1975). Child-rearing patterns are reflected in the kind of games that the society emphasizes, whether they be games of strategy, games of chance, or games of physical skill (Ellis 1973; Ager, 1975; Sutton-Smith 1972; & Zaslavsky 1973).

Games of strategy appeared in societies that emphasized obedience and submission to others. The rules of the games are such that the player forces his or her opponent into submission. In strategy games, there is an opportunity for the player to control his or her opponent. This may cause the one controlled to have aggressive feelings, but, because she or he is in a play situation, she or he is forced suppress the aggressive emotions. This is similar to the father-child relationship. The child as an individual has his or her own wishes but cannot pursue them, especially if they are against the father's will. As a result the child becomes annoyed but cannot reveal it to the parent.

On the other hand, games of chance dominate children's play in societies where children are reared for responsibility and the necessity for routine. In the game of chance, the player doesn't control the circumstances of the game, but has to accept the results as they come. Likewise, in the society's rearing patterns, the children are not expected to reason but to do exactly as they are told to do: a way of accepting the responsibilities in life without questioning the authorities.

In societies where performance or achievement are valued, games of physical skill are preferred. In such societies, an anxiety to compete is induced in children so that they are determined to always perform well. Such a competitive spirit is therefore generated by pressuring the child consistently in terms of performance (Ellis, 1973).

Physical-skill games are played mostly by older children. They include, among others, running games, hopping games, manipulative, and catching games (Sutton-Smith, 1972). These games are not universal. They are cultural inventions and relate to the levels of the complexity of the society (Sutton-Smith, 1971).

Games, therefore, provide children with the kind of education needed for their survival in adult life. They are the means through which the children get to know themselves and their environment. Through playing games children develop cognitively, physically, socially, and emotionally.

Children's games change from generation to generation as their game preferences change with age. As children grow up they prefer some games over others. Also the preferences of girls are initially different from the preferences of boys (Opie & Opie, 1969). However, it was noticed that, as time passed by, girls' preferences for games resembled those of boys. Sutton-Smith (1972) attributed this change of preferences to a change in women's role in today's society. More women are working than before. Boys, on the other hand, do not like to be associated with girls. They prefer a masculine type of play such as wrestling, throwing darts, and snowballs. It is likely that preferences for both groups, boys and girls, are determined by their social world.

Nevertheless, when cultural games are used in classroom teaching, teachers have to make sure that both sexes participate equally in the game. This will guard against discriminating between genders. For example, spatial-skill games may be played mostly by boys in many societies, and if such games are used in the classroom instruction, girls will also have the chance to develop their spatial and problem-solving skills.

Games and Mathematics Learning

Games are devices through which children interact and understand their world. Apart from testing wit, games arouse interest and pleasure in children of any age and help develop positive attitudes toward a task, thus motivating the participant (Ellis, 1973; Klann, 1980; and Matsela 1990).

Play allows the children self-expression, enjoyment and some freedom of venturing into new ideas and exploring them. In play, children are an active participants and play makes their environment desirable and conducive to satisfying their curiosity when they engage in appropriate play activities. That is, the children and the environment coconstitute each other (Berg, 1989).

Effective learning at all stages and in all areas of development entails an active involvement, a ceaseless struggle with meaning, and a prolonged effort of mind to change and reshape the experience.

Everton (1990) argued that when children are given the responsibility in learning, they are placed in situations where it becomes important for them to communicate, to discuss, to negotiate, and to converse with their fellows and their teachers.

There must be an emphasis on meaning in learning, and teachers must respect the individual's language, culture, thought, and intentions. Learning is fundamental and interesting when the learner's source of motivation is from within (Dewey, 1933; Katz & Chard, 1989).

To most teachers, it is difficult to cater or even observe individual differences because of the size of class and prescribed curriculum. Teachers' energy and time are used up in creating a classroom atmosphere where creative thoughts, imaginations, and better relations flourish. However, no two children are alike. Children are different in nature and ability, and the range of variation found in every classroom is enormous. The whole child-self comes to school, and this whole child-self should be catered to in the classroom (Moustakas, 1966; Winteridge, 1989).

Mathematics more than any other subject must involve the whole person of the child: the body, mind, emotions, and aesthetic sensibilities (Winteridge, 1989). It is very important that children experience the joy of achieving personal success in thinking and of having their own ideas. Enjoyment in learning is intrinsically linked with success. It is also a vital element in education without which the whole personality cannot be engaged in the learning process.

Games generate enthusiasm and excitement in children. They provide the opportunity for total involvement and enjoyment, and as a result learners may become motivated and immerse themselves in mathematical activities. It is in this way that games can enhance learners' attitudes towards mathematics (Ernest, 1986).

The Cockroft (1982) report suggested a variety of activities in the mathematics lesson. These include exposition by the teacher; discussions between the teacher and the pupils and between the pupils themselves; appropriate practical work; consolidation and practice of fundamental skills and routines; problem solving, including the application of mathematics to everyday situations; and investigational work. All of these could be achieved through the integration of games in a lesson.

Through the use of games, learners are able to discuss mathematical issues among themselves and between them and the teacher. Because of the non threatening atmosphere in most game settings, learners are free to try various strategies. Through trial and error, learners help each other to amend their thoughts, thus investigating new mathematical ideas and developing problem-solving strategies (Ernest, 1986).

Mathematics teaching involves much practice to reinforce newly acquired skills, and the use of games may reduce the stress of the heavy doses of the exercises that teachers usually give to students. Games in a mathematics classroom therefore, can be used to encourage cooperation, discussion, and active involvement. Learners learn mathematics by doing, not through passively listening to the teacher. The learning environment must be rich with shapes, sand, and clay that children can handle (Winteridge, 1989). Ernest (1986) also commented:

> The success of mathematics teaching depends to a large extent on the active involvement of the learner. Children learn mathematics by doing and by making the concepts and skills of mathematics their own. Children cannot play games passively, they must be actively involved, ... Thus games encourage the active involvement of children, making them more receptive to learning, and of course increasing their motivation. (p. 3)

Games can provide a stress-free environment and an appropriate level of activity for learners. The learners' actions reveal more about their strategies, and this gives the teacher the opportunity to know children better through observation.

Complex decision making can be accomplished within this play of games, and games can provide a conducive, risk-free active, exploration of serious intellectual and social problem (Matsela, 1990). Games are also recommended for remedial lessons for slow learners because they provide an environment which does not allow feelings of failure, rejection, or insecurity (McEvoy, 1991).

The studies reviewed here on the use of games in mathematics education dealt with commercial games. None of them are on the use of traditional games in mathematics teaching. Therefore, there is need to look at the integration of cultural games in mathematics teaching.

Cultural Games and Constructivist View of Mathematics Learning

Knowledge that empowers centers around the interests and aims of the learner. Without the learner's concern, knowledge cannot affect his or her desires and purposes. Thus, it is the learner who is at the center of the enhancement of personal power (Freire, 1970; Sleeter & Grant, 1991).

It is true that mathematics education should help all learners acquire mathematics knowledge which empowers. Sleeter and Grant (1991) take this to imply that curriculum should include a perspective of history from the student's point of view and be selected and constructed in relation to the student's desires, visions, descriptions of reality, and repertoires of action. Usually, learners who cannot cope with the school experience do not see any congruence between the knowledge gained at school and the knowledge with which they come to school (Thompson, 1994).

Children of all ethnic backgrounds, girls as well as boys, are equally capable of learning mathematics, provided that it is presented in an understandable manner (Zaslavsky, 1979). Children in Africa, as in other parts of the world learn, finger counting and rhythms even before they are aware of the number sequence (Zaslavsky, 1973). Their background knowledge could be incorporated in classroom teaching so that children could see some congruence between school knowledge and the knowledge they bring from home. Acquisition of concepts require maturity and adequate background.

Furthermore, Thompson (1994) noted that children continue to use their counting algorithms even up to the seventh grade, and that most of the time children do not use teacher taught algorithms but replace them with their own. It is not only the children who persist in their informal methods. Lave, Murtough, and de la Rocha (1988) found that even adults use informal algorithms in their daily activities such as shopping and budgeting. Therefore, children's informal methods of constructing knowledge are crucial to their future use in mathematics learning.

Carpenter et al (1993) also realized the importance of children's informal knowledge to classroom instruction. They reported that when children solve problems they make a model of the problems (questions) first. This kind of modeling is evidenced in children's counting, measuring, weighing, ordering, and sorting games.

It is suggested that when cultural games are used in mathematics teaching, children will not only accumulate information but will also have the opportunity to develop mathematical understanding. This is possible because classroom instruction is built upon children's existing knowledge. Games of strategy, for example, can provide a good setting for mathematical problem solving because the search for strategies demands mathematical thinking (Kissane, 1986). In this case the mathematical problems of finding strategies are purposeful because they have to be formulated by learners. Regardless of how many failures they have met in the process, there is a strong motivation to make progress towards a solution because of the instant effect of playing a game (Ainley, 1988).

Therefore, from these studies and others reported elsewhere in this thesis, one may infer that cultural games posses some pedagogical importance in mathematics teaching. They can help teachers make their children see the relationship between their idiosyncratic methods and the classroom instruction methods and see their cultural activities as a source of educational knowledge. Children may have the opportunity to share their ideas with others.

Finally, games can provide a balanced program for children's education. They can provide the child with an environment conducive to cognitive, social, emotional, and physical development.

Chapter Summary

Formal mathematics teaching does not fit well with the children's way of learning because it is based on the teacher telling and practice mode (Baroody et al., 1990), an example of abstract instruction. When instruction is conducted in an abstract and lockstep manner, it makes little sense to many children, and they are forced to memorize mathematics in a rote manner. Often this experience leads children to construct negative beliefs about mathematics that create a barrier to further learning and problem solving. Charles and Lester (1982) reported that this kind of experience usually takes place at the end of the elementary level, after which the child adopts it as she or he thinks about mathematics use in adult life.

The Cockroft (1982) report also argued that by the end of the primary school years children's attitudes towards mathematics are becoming fixed, and as a result the way the child will relate to mathematics in the future is affected. The implication of this argument is that if children have negative attitudes towards mathematics at the end of their primary education, these attitudes may have detrimental effects on their secondary education. If the attitudes are positive, children will be eager to learn more mathematics in their secondary years of education.

Children spend most of their time and effort reflecting on tasks that have stimulated their curiosity. Thus, meaningful learning occurs when children are actively engaged in a subject intellectually and emotionally, and it occurs when learners are given an opportunity to assimilate knowledge. For primary school children, this means interpreting the school-taught instruction in terms of their relatively concrete informal knowledge. Mathematical symbols and computational algorithms can make sense to children if they are connected to their existing, personal counting-based knowledge of mathematics gained through play.

Baroody et al. (1990) argued that the gap between formal instruction and children's existing knowledge may prevent assimilation of mathematical concepts by learners. They stated that it happens because the gap separates the school-taught skills and concepts from this informal knowledge; therefore, the school-taught skills and concepts seem foreign and difficult to children.

It seems reasonable, therefore, to incorporate traditional games in mathematics teaching because the literature reviewed on the use of commercial games in learning and teaching situations showed that

1. games can close the gap between school-taught mathematics and informal knowledge of numbers. Children come to school with some knowledge of counting, sequencing and ordering. The teacher needs to incorporate the child's background into the curriculum (Baroody et al., 1990; Cobb et al., 1990);

2. games provide an interactive environment where learners are given the opportunity to construct mathematical knowledge (Castle, 1965; Cobb et al., 1990; Van Hoorn et al., 1993; Yardley, 1988);

3. games allow total engagement and involvement. Learning is meaningful if children's minds are totally engaged. The motivation for learning should come from within (Castle, 1965; Dewey, 1933; Suffolk, 1982);

4. games provide practical work. Children experience measurement and volume through, for example, handling sand and clay, rope skipping, and so on;

5. games provide developmentally appropriate curriculum. With games the teacher can provide age-appropriate activities congruent with the child's growth. During play "[c]children select both the content and the level of difficulty" (Van Hoorn et al., 1993);

6. games add enjoyment to learning situations. As learners enjoy doing mathematics tasks, they are motivated to investigate difficult tasks and make conjectures. They are happy to be successful in constructing their own ideas, thus developing positive attitudes towards mathematics (Cobb et al., 1990; Klann, 1980); and

7. games provide the learners with the opportunity to make mathematical predictions, conjectures, and generalizations. Learners are used to the idea of checking their answers and justifying them (Ainley, 1988). Cultural games when used in classroom teaching may also provide these positive results.

The literature reviewed in this chapter was on the use of commercial games. Literature on the use of traditional games in classroom teaching was not found. The general aim of this study, therefore, is to look at how teachers of lower primary levels in Botswana use traditional games in mathematics teaching and also to find the extent to which they are doing so.

CHAPTER III

THE RESEARCH DESIGN

The purpose of this study is to determine the extent to which grade 2 and 3 teachers in Botswana Central District primary schools use cultural games in mathematics teaching. How and why teachers use these games was the second important aspect of the study. This chapter describes the research procedures and also outlines the methods of investigation employed in this study.

The Research Method

The descriptive survey method of investigation was used for this study because it enables one to “gather information from a large sample of people with less effort and expense..." (Mitchell & Jolley, 1992, p. 451). According to Leedy (1974), a survey research could be the most favorable because it is believed to be "the method of research that simply looks with intense accuracy at the phenomena of the moment and then describes precisely what the researcher sees..."(p. 79). Mitchell and Jolley noted that surveys are used most often to assess people's beliefs, attitudes, and self-reported behaviors. In this study the method was used to explore teachers' attitudes, values, beliefs, and experiences about the use of cultural games in the teaching of mathematics.

Two observation techniques were used to gather the data: a mail-out questionnaire and an interview schedule. Many researchers, for instance, Leedy, (1974), Mitchell and Jolley (1992), and Hoinville and Jowell (1977) believed that when these two techniques are used together, the information gathered is more or less complete because they augment each other; the disadvantages of one become the advantages of another. For example, the send-off questionnaire is inexpensive but cannot provide probes which are used to solicit more information in an interview schedule.

Construction of Data Collection Instruments

The Questionnaire. "A commonplace instrument for observing the data beyond the physical reach of the observer is the questionnaire... (Leedy, 1974, p. 81). It can be used to reach subjects in isolated areas where the interviewers cannot reach. Hoinville and Jowell (1977) pointed out two more advantages: It also allows the respondents time to reflect on the questions in order to give more precise records and it is used effectively for screening purposes to identify a particular minority group of respondents for subsequent interview.

The questionnaire used in this study was constructed by the researcher with the help of her supervisor and a professor in the Department of Elementary Education, University of Alberta. The two helped the researcher to assess it for face validity--the extent to which it looks, on the surface, to be measuring what the researcher intends to measure; and, content validity -- the extent to which it represents a balanced and adequate sampling of relevant dimensions, knowledge, and skills in this study.

The questionnaire was developed with the following factors in consideration:

1. Time - The time for completing the questionnaire should be between 20 and 30 minutes (Hoinville & Jowell, 1977; Survey Research Center, 1969).

2. Clarity of questions - Because there was no one to provide further explanations, questions were worded with care so that the probability that they would be clearly understood was increased.

3. Layout- The order of questions in the questionnaire was "in such a way that they follow each other naturally" (Survey Research Center, 1969). The more demanding questions were placed towards the end of the questionnaire.

d) Ease of completion -The instructions for questionnaire completion were made as easy as possible; for example,

[I]n the following statement, indicate your agreement or disagreement with the statement by making a tick in the appropriate box.

(SA = strongly agree, A = agree, NS = Not Sure, D = Disagree and SD = strongly disagree)

	SA	A	NS	D	SD
Botswana's economy is going down because of lack of expertise in local companies.	( )	( )	( )	( )	( )

The questionnaire was developed through a series of four draft documents which were reviewed for face and content validity by two professors and other graduate students who are practicing teachers. The fifth draft was the one used for data gathering. The first draft was constructed after reviewing pertinent literature; it was broad, having too many categories ranging from classroom teaching to day-to-day life activities such as shopping, as well as probing about floor and wall decorations. In addition, there were open-ended questions that would demand a great deal of thinking from the teachers; for instance, they were to figure out the names of the cultural games and to give detailed suggestions on how cultural games could be used.

To improve this draft a list of cultural games was compiled after consulting three Batswana students in Edmonton, two of whom were at the University of Alberta; the third was from the Northern Alberta Institute of Technology (NAIT). Of these three, two came from the Central District (Central Central and South Central) of Botswana--a place where the study took place. Therefore, the collection was regarded as representative of "common" cultural games in the area where the research was to take place.

In the instrument, teachers were given this list of games and were asked to indicate the extent to which they used them in the classroom. If they were not familiar with the game, they indicated so. The same list was used in one open-ended question where teachers were asked to indicate mathematics topics in which they integrate the game(s) and for what purpose(s).

The purposes of the revisions in second and third drafts of the questionnaire focused on format and the layout. The concern here was on how it would appear in the eyes of the respondents. "More important perhaps than the length of the questionnaire is its appearance. The task required of respondents must appear easy and attractive" (Hoinville & Jowell, 1977, p. 127). The content level, definitions, and overall format were considered. The fourth and fifth drafts were of a different format which focused on easy data entry and analysis.

Because of time constraint and shortage of funds, the final draft of the questionnaire was not piloted in Botswana as initially planned, but was given to two long-service primary teachers in Botswana to read and to make comments on its contents and style. On the whole, they found the questionnaire interesting and easy to complete. Minor corrections in editing were made according to their advice.

The questionnaire used in this study had two parts: Part 1 (Personal and Professional Background) and Part 2 (Use of Cultural Games in a Mathematics Lesson). Part 2 was further divided into Categories A and B. Part 1 of the instrument was designed to collect demographic data so that teachers could be identified by gender, age group, standard (grades) they were teaching, and academic qualifications.

Part 2 Category A (Games and the Curriculum) was used to gather information on the general use of games, either cultural or commercial, in the lower grade curriculum of the primary school. In Category B (Games and Mathematics Teaching) of Part 2, Sections I, II, and III were used to gather data on the use of cultural games (specifically) in the mathematics curriculum; and Section IV solicited information on mathematics concepts embedded in a specific traditional game: 'mhele' (see Appendix A).

Items in the questionnaire were constructed to allow easy reading and recording by respondents. This is because the researcher knew that teachers would not have much time to read and respond. In fact, the research was conducted during the beginning of the year when teachers had little time to complete the survey instrument. Possible responses were given, and teachers were asked to tick the statements that they thought agreed with their opinions, experiences, and attitudes on the use of traditional games in the teaching of mathematics.

However, there were two open-ended questions in the questionnaire. In one question, a list of cultural games was given, and teachers were asked to provide the topics in which they could integrate each of the games and how they used each specific game.

Another open-ended question was on the application of the 'mhele' game, one of the popular games among the young and old in the country. In Lesotho, where the game is known as *murabaraba*, mathematics teachers recommend it to their children, and a recent study (conducted in that place) showed that children who knew the game did better in their school geometry lessons than those who had never played it (Zaslavsky 1982). In this instrument teachers were asked to identify the mathematics concepts on the 'mhele' diagram, the skills learned in playing the game and how they could modify the game to suit learning and teaching situations in their classes.

The Interview Schedule. The interview schedule used was semi-structured in a format which "is sufficiently flexible to allow additional questions to be asked at any point" of the interview (Thompson, 1993, p. 84). Although the structured format makes the data analysis easier to organize, it forces the interviewer to anticipate probes, and this is sometimes difficult to achieve. In addition, the structured interview might result in a tense atmosphere where the participants feel insecure and the researcher may face difficulty in addressing important issues that arise during the interview.

The main purpose of the interview was to enrich and augment the data collected through the mail-out questionnaire. Although questionnaires are less expensive devices to be used for a large survey, they do not reveal detailed opinions of the teachers; also, they could not provide probes for further clarification. Thus the use of the interview to complement the survey data was a necessity. The interview therefore dealt with how teachers regard traditional games, how teachers can help students link the concepts from playing games with mathematics, and how teachers view the results of using the games in mathematics instruction.

The first draft of the interview schedule was written based on the statement of the problem and the questionnaire items. The second draft focused more on three aspects: first, how the instruction is conducted when games are employed; second, how the teacher might help children relate the concepts they got from playing a game to mathematics in their curriculum; and finally, how teachers help children see their own culture as a source of knowledge and understanding.

Sample Selection

Because of fiscal and time constraints, the survey was conducted in one district, the Central District, Republic of Botswana. The Central District has large villages and rural areas and 209 elementary schools, of which 191 are local government schools, six are government-aided, and twelve private (Republic of Botswana, 1991). Because private schools, or at least some of them differ in structure and in the amount and types of facilities from the other categories, they were not deemed typical of primary schools in Botswana. Therefore, the sample of 100 schools used was from the 197 non private schools. Two teachers from each school participated in the study. These were teachers who had taught standard two or three classes in the previous year, 1993.

Teachers from lower primary grades were chosen because of the nature of the children they are teaching. Young children learn through interaction with their physical environment (Yardley, 1989), and it is through play that children satisfy their curiosity and understand their surroundings (Dohler, 1992; Skemp, 1989; Van Hoorn et al, 1993;). Thus, the researcher assumed that teachers for standards two and three classes in the

Central District, Botswana, might use traditional games in their classroom instruction to provide an environment conducive to interactive and discovery learning.

Permission to invite teachers to participate in this study was sought from the Office of the President, Republic of Botswana. This office in turn contacted the concerned district councils so that proper records were kept according to the National Institute of Development Research and Documentation (NIDRD, 1981) *Guidelines for Research.*

Data Collection Procedures

Administering the Questionnaire Two hundred copies of the questionnaires were sent to 200 teachers from a sample of 100 schools (out of 197) in the Central District. One hundred packages were prepared containing two questionnaires; two stamped return envelopes; two letters for teachers; one letter to the headmaster; and a copy of the permission letter from the Office of the President, Republic of Botswana.

In their covering letters, each headmaster was asked to select two teachers: standard two teacher and standard three teacher, and to give each teacher one questionnaire, one stamped return envelope, and a covering letter (for teachers). The letters to the headmasters and teachers explained the nature of the research and solicited their cooperation. The letters promised confidentiality of teachers' responses and included the option for them to opt out of the research. The teachers were to use the stamped return envelopes to return the responses to the researcher.

Out of 200 questionnaires 84 were hand delivered and 60 were collected in a radius of about 120 km from the researcher's base, and the potential interview participants were located in this area.

Reminder letters were mailed three weeks after the date of mailing the questionnaires. In response to this note, more questionnaires were returned, raising the total return rate to 73%. This rate was higher than the researcher anticipated, considering the conditions under which teachers were working. These conditions included preparing schemes of work and lesson plans, allocating new students to classrooms, and cleaning and clearing up the school vicinity.

The actual respondents to the instrument varied in age from under 30 to 50+ years most of whom have a Primary Teacher Certificate (80.7%) as their highest academic qualification. Other qualifications include Elementary Teachers' Certificate (14.5%), Primary Lower Certificate (2.1%), Advanced Teachers' Certificate and Primary Higher Certificate (0.7% each). Among the respondents were 76 (52.4%) standard two teachers, and 69 (47.6%) standard two teachers, making a total of 145. The sample was sufficiently covered in the returns.

Conducting the Interviews. As well as serving as research data in their own right, the questionnaire responses were used to screen potential participants for the subsequent interview. Participants in the interview included those teachers who indicated that they used games, those who left out some parts of the questionnaire, and those whose responses seemed well thought out but inconsistent. The potential participants were contacted either in person or by phone. In cases where the teacher was in class, the headmaster was asked to inform him or her and pass on the request for an interview. Ten teachers were interviewed.

Interviews were conducted at the school of the respective teacher in secluded places to avoid interruption by either other teachers or pupils. Before each interview, the participants were assured that their identity would be kept anonymous; that there was no right or wrong answer to any of the questions, that they were free to use any language (English or Setswana) with which they were comfortable, and that they were free to decline if they felt they no longer wanted to take part in the interview. The duration of the interview was 15 to 30 minutes with the exception of two cases that took 45 to 60 minutes. The interview proceedings were tape recorded. Interview data was taken from the transcripts of the tape recordings and the recordings themselves.

Although teachers were very willing to talk about the usefulness of the cultural games in the classroom, they seemed to have difficulties in speaking freely despite the effort of establishing a rapport with them before the interview. They talked much about their experiences before the tape recorder was activated; as soon as the tape recorder was on, it was more difficult for some of them to produce responses. This might have been a sign of lack of trust in the interviewer and her intentions.

Moreover, as mentioned elsewhere in chapter I, supervision of teachers (by headmasters) is emphasized as an efficient way of improving classroom instruction, and some teachers might have suspected that the interviewer was checking on their day-to-day practice. In fact, interviewing is regarded as entering someone's life (Thompson, 1993). Few teachers seemed to wish that their thoughts, opinions, and practices be known to the authorities, especially if this could lead to unfavorable results in evaluation of them and their teaching.

Once the interviews had ended and the tape was off, the interviewees discussed freely the issues and their experiences of interactive teaching. However, it was difficult to take notes because doing so would have shut them off, making them more suspicious. Thus both for ethical and practical purposes, as well as for the sake of reasoning from data which were clear and appropriate by the respondents, only the tape-recorded responses were used in the analysis.

All ten teachers interviewed were female. Two were under 30 years of age; four were above 30 but under 49 years of age; and the last four were all above 50 years of age. Six hold a PTC as their highest academic qualification, one holds an ATC and three hold an ETC as their highest academic qualification.

All the interviewees indicated some advantages and disadvantages in using the games in teaching. Some of these mentioned included the following: arousing learners' interests, providing a relaxed and non threatening atmosphere, moving from the known to the unknown, and losing time through improper preparation.

The teachers interviewed indicated that they used games but mainly in other subjects than mathematics because it was easy to incorporate them in these subjects. In social studies, for instance, teachers used games and played songs to teach children their culture, and that made the teaching much easier. In fact, they added that if it were possible, they would prefer to have a written guide to enable them to use these games in mathematics teaching, as is the case with other subjects.

Thus ,these interviewees appeared to each have a range of articulated values on the use of cultural games and hence were appropriate subjects for this study.

Problems Encountered During Data Collection

Initially fifteen teachers were to be interviewed; however, because of teachers' transfers to different schools during the duties available, only ten were interviewed. Most of the transfers took place between January 31 and February 18, the weeks in which interviews were conducted. More than once the researcher visited schools hoping to conduct an interview but was disappointed to learn about the transfer of the potential participant. In the same manner questionnaire returns were affected. Having transferred to new schools, teachers did not feel obliged either to fill in or to return questionnaires. They were now free because headmasters who chose them and gave them these questionnaires would not know whether they were returned or not.

Data Analysis

Analysis of the Questionnaire. The results of Part 1 were used to describe the sample used in the study (tables 1, 2 and 3). The results of Part 2 were used to determine the extent to which primary school teachers in the Central District, Botswana, use traditional games in the teaching of mathematics. Three independent variables were identified as important to this study. These are teachers' qualification, teachers' years of experience, and cultural games. The chi-square statistic was used to see if there is any relationship between these variables. The hypotheses tested were:

Ho 1: There is no relationship between the use of cultural games and teacher's qualification

Ho 2: There is no relationship between the use of cultural game and years of teaching experience

These tests were based on frequency counts of responses to questions identifying the years of teaching experience and qualification. The results of these questions are tabulated in Tables 4 and 5. These tests were seeking to answer question 5 of the study. A table format is used to present the responses to some questions in the next chapter.

Presentation of Interview Information

The interview data is presented in the qualitative analytical form to enrich the data gathered through the questionnaire. A total of eight questions were discussed with each of the ten interviewees. The responses are summarized question by question, and the overall interview data are used to augment the questionnaire results.

Chapter summary

In this chapter the research design and the descriptive survey method that was employed in the study was described. Information was provided on the selection of the sample, the purpose of the study, the development of the data-collection instruments used, and the data analysis. The testable hypotheses were stated. The results of the summary are reported in chapter IV, the next chapter.

CHAPTER IV

FINDINGS AND DISCUSSIONS RELATED TO THE USE OF TRADITIONAL GAMES IN MATHEMATICS TEACHING

Introduction

In this section data derived from the questionnaires and interview conducted in Botswana on the use of cultural games in mathematics teaching are reviewed.

The focus of the study is:

1. to determine the extent and the modes of use of cultural games in mathematics teaching by standard two and three teachers in the Central District, Botswana

2. to determine the relationship between:

a) the respondents' years of teaching experience and the use of cultural games in mathematics teaching, and

b) the respondents' qualifications and the use of cultural games in mathematics teaching, and

3. to determine, through the use of open questionnaire items around one cultural game, the mhele game, teachers' views of the potential for using cultural games in the teaching of mathematics.

The results of the questionnaire are organized around the research questions posed for the study. The data is presented in a tabular form, where appropriate.

Questionnaire Responses

Participants were from small schools in remote areas and big schools in villages with a total range of 4 to 33 teachers, respectively. A total of 200 questionnaires were sent to teachers who were teaching standard 2 and standard 3 in 1993 in the Central

District. One hundred and forty-eight questionnaires were returned, making up a 74% response. Of this number, three questionnaires were not used in the data tabulation and analysis because they arrived late. Teachers from 83 schools out of 100 responded. Thus it is assumed that the questionnaires came from a basically constituted sample of teachers and schools.

Part 1 Responses

Part 1 of the questionnaire was designed to gather information which would assist in describing the sample of the teachers participating in the study. Table 1 summarizes the data on the personal and professional background of the participants. These data include gender, age, qualifications and teaching experience.

Certification The majority of the participants (80.7%) have a Primary Teaching Certificate (PTC) as the highest academic qualification. However, it is expected that teachers of lower grades would hold Primary Lower Certificate (PLC) whereas those of higher grades would hold a Primary Higher Certificate (PHC). However, as a result of a change in the Teacher Education Program in the early 1970's, the Primary Lower Certificate, Primary Higher Certificate and Elementary Teaching Certificate (ETC) were replaced by the Primary Teaching Certificate (PTC), as elaborated in the next paragraph.

At the time of independence (1966), there were three types of training for teachers: The Elementary Teachers Certificate (ETC), which took three years to complete, was for upgrading untrained teachers. Students were full time at college for six weeks after which they had to finish the course through correspondence. The second course, the Primary Lower Certificate (PLC) was a full-time three-year course, and its graduates were to teach standard one to four. In this course, much emphasis was put on the subject matter because students were weak in mathematics and other subjects. Unlike other courses, Primary Higher Certificate (PHC) entry was a Junior Certificate. Students in this course were trained to teach high classes in schools, that is, from standard five to seven. It was a three-year course.

However, all these courses are no longer offered; instead, a two-year course, Primary Teachers' Certificate (PTC) is offered at the four Teachers Training Colleges (TTC): Lobatse TTC, Tlokweng TTC, Serowe TTC, and Francistown TTC. The course is offered to untrained teachers with two years of teaching experience, Junior Certificate holders, and those who attempted the Cambridge Examinations (Jensvold, 1989).

Part 2 A Responses

Table 2 shows the types of games used by teachers in the classroom instruction of other subjects.

Use of Games. Most of the teachers (80.7%) used commercial games without any modification. This may be because the rules of these games are explicitly explained for classroom use. In the case of traditional games, most teachers (56.6%) either modify the game for themselves or use the rules or game setting suggested by their students (56.6%). The teachers interviewed did not usually get ideas from other teachers. Only 34.5% of them use cultural games modified by a colleague. It is also interesting to note that 55.9% of teachers develop and use games (see Table 2).

Table 3 shows the proportion of teachers who integrate games in other subjects. In social studies 82.1% of the participants integrate games in the subject; in English, 75.9%; in Setswana, 74.5%.

Table 1

Personal and Professional Background Information

	Number of teachers	% of responses
Highest academic qualification		
1. PTC	117	80.7
2. ATC	1	0.7
3. ETC	21	14.5
4. PHC	0	0.0
5. PLC	3	2.1
6. Others	1	0.7
7. NA1	2	1.4
TOTAL	**145**	**100.0**
Years of teaching experience		
1. Under 5	47	32.4
2. 5 - 9	43	29.7
3. 10 - 14	20	13.8
4. 15 - 19	15	10.3
5. 20 +	19	13.1
6. NA2	1	0.7
TOTAL	**145**	**100.0**

(Table Continues)

	Number of teachers	% of responses
Years of teaching standard 2 or 3		
1. Under 5	112	77.2
2. 5 - 9	20	13.8
3. 10 - 14	6	4.2
4. 15 - 19	2	1.4
5. 20 +	2	1.4
6. NA3	3	2.1
TOTAL	**145**	**100.0**
Ages of participants		
1. under 30	48	33.1
2. 30 - 49	72	49.7
3. 50+	21	14.5
4. NA4	4.0	2.8
TOTAL	**145**	**100.0**
Gender of participants		
1. Female	133	91.7
2. Male	9	6.2
3. NA5	3	2.1
TOTAL	**145**	**100.0**

NA = Not applicable
NA1 = Did not indicate their highest academic qualification
NA2 = Did not indicate years of teaching experience
NA3 = Did not indicate years of teaching standard 2 or 3
NA4 = Did not indicate their age
NA5 = Did not indicate their gender

Table 2

Types of Games

Types of Games	Number of teachers	% of response
1. Commercially published game	117	80.7
2. Commercially published game modified by the teacher	35	24.1
3. A game developed by the teacher	81	55.9
4. A game developed by a colleague	45	31.0
5. Cultural game modified by the teacher	82	56.6
6. A cultural game modified by a colleague	50	34.5
7. A cultural game suggested by learners	82	56.6

In the last two subjects the influence of using games may come from the Breakthrough Method, where the children are encouraged to learn to read and write using practical activities. One teacher during the interview reported that she modified the card game to teach Setswana spelling . She put one word on two cards and gave one card to the learner. She dropped the card, and if the learner recognized the word, she or he would drop the card having the same word. She called it a discrimination method where eye contact and memory are valued.

Part 2 B Responses

Tables 4 and 5 show the relationship between respondents' qualifications, years of teaching experience, and the use of cultural games in mathematics teaching.

Comparison between qualification, years of teaching experience and the use of cultural games To investigate the relationships between teachers' cultural game use and various demographic variables about teachers, a tactic of passing a series of testable hypotheses was used. Contingency tables were developed and the chi-square statistics was used to test for deviation from the null hypothesis and hence for such relationships. The results are as follows:

Ho 1: There is no relationship between the use of cultural games and teachers' qualifications.

$\chi^2 = 3.583$, $df = 4$, $p > .05$

Ho 2: There is no relationship between the use of cultural game and teacher's' years of experience.

$\chi^2 = 7.843$, $df = 4$, $p > .05$

Neither hypothesis was rejected. Hence we can conclude that there were no relationships between teachers' use of cultural games, teachers' qualifications, and teachers' years of teaching experience. However, we do not dispute the possibilities of relationships between these variables.

Despite these results, one would expect teachers who had recently graduated from colleges to use games more than the long-service teachers because of the current innovations (Breakthrough and Project Methods) in the teacher-education curriculum. There has been a move to include child centered methods in instructional courses (Backhouse et al, 1992; Hunter, 1967; Karz & Chard, 1989; Van Hoortn et al., 1993). This move discouraged the traditional style where the teacher is regarded as the sole knower and where children are expected to be passive receivers. The new graduands (i.e. those who in this study have taught for less than 5 years) should have been the majority of teachers using games in their teaching. This is not the case. Instead, more than 60% of the long service teachers (having 20+ years of teaching experience) are the ones using cultural games in mathematics instruction.

This may mean that new teachers are not yet able to integrate games into the curriculum smoothly. They may be having problems similar to the ones encountered in the implementation of the Project Method. These problems concern the time schedule: Teachers are not able to handle children's projects in the already tight timetable, and as a result abandon the projects. It is likely that inexperienced teachers face a challenge similar to this one when integrating games in the classroom. Alternatively, it may mean that teachers have never thought of using cultural games in mathematics instruction; hence a lack of relationship between teacher's qualification and years of teaching experience.

Table 3

Subjects in which games are integrated (besides mathematics)

Subjects	Number of teachers	% of response
1. Social studies	119	82.1
2. Setswana	108	74.5
3. Science	78	53.8
4. Religious education	76	52.4
5. Agriculture	63	43.8
6. English	110	75.9
7. Art	77	53.1
8. Others	16	11.0

Table 4

Use of Cultural Games in Mathematics Teaching and Teachers' Qualifications

USE OF GAMES	Frequency of use				
	PTC	ATC	ETC	PL	Others
More than once	66	0	14	1	1
Not used	51	1	7	2	0
TOTAL	**117**	**1**	**21**	**3**	**1**

$\chi^2 = 3.583$, $df = 4$, $p > 0.05$

Table 5

Use of Cultural Games in Mathematics Teaching and the Years of Teaching Experience

USE OF GAMES	Frequency of responses				
	under 5	5-9	10-14	15-19	20+
More than once	22	29	8	10	13
Not used	25	14	12	5	6
TOTAL	**47**	**43**	**20**	**15**	**19**

$\chi^2 = 7.8432$, df = 4, $p > 0.05$

There is also no relationship between teacher's qualification, years of teaching experience and the use of other (commercial) games in mathematics teaching. Tables 6 and 7 report these results.

Teachers in this study have indicated that they used commercial games more than cultural ones. This is clearly shown by the results in Tables 6 and 7. For instance, 90.7% (see Table 6) of teachers having less than five years indicated that they use commercial games compared to 65.1% of teachers in the same group who use cultural games (Table 5). Further still, there are only 40.0% of teachers with 10 to 14 years of teaching experience who used cultural games, and as many as 80.0% of teachers in the same group who used commercial games in mathematics teaching (tables 5 and 6).

As mentioned before, these results show how teachers, and headmasters regard cultural games in teaching. Commercial games are preferred because they have pre-prepared materials and instructions. However, teachers with more than twenty years of teaching experience use both games equally. One would wonder what these results mean to teacher education and curriculum. Does this mean that long-service teachers are familiar with the pros and cons of using cultural games? That is, do these teachers know how to select the games with the same needs and objectives of the topic better than the less experienced teachers?

Similarly teachers with Primary Teaching Certificates use commercial games more than they use traditional ones (Tables 4 and 7).

The Frequency of Game(s) Use. Table 8 shows the number of teachers who indicated that they have used traditional games either often or very often. It also shows the topic of integration for each game and the purposes for using the games.

The most frequently used game is dibeke (80.7%), and the least frequently used games are mhele and koi, with a frequency of 59.3% each. One would expect diketo, koi, and mhele to take the lead because they are the most common street games. However, it is those games with simple application of number operations and counting that are common. In addition, dibeke has a number of versions such as bottle counting, stone counting, ball dodging, and continuous counting, and this could be the reason why the game has a high frequency of use.

Moreover, Opie and Opie (1969) have observed that children's attitudes towards the games they played when young change as they grow up. It could be that children have developed some ambivalence toward both diketo and koi, and as a result teachers use them less frequently.

Turner (1989) asserts that children are prominently movement oriented, and as a result they would learn effectively when physical activity operates at a maximum level in school subjects, especially mathematics. There is a lot of body movement involved in the 'dibeke' game, and Batswana children might like the game for its movement orientation. Turner supported the idea of teaching mathematics through ethnomathematics medium whereby the teacher teaches sorting, ordering, counting, measuring, and weighing by relating to the way children have experienced these concepts before coming to school.

It has been documented (by Opie & Opie, 1969; Sutton-Smith, 1971; Turner, 1989; and Zaslavsky, 1973;) that before coming to school children get involved in physical activities such as sandplay, mudplay, circle games, stoneplay, running and racing games, target games, physical skill games, guessing games, etc. Such activities give children the experience of counting, sorting, ordering, weighing and measuring, the concepts needed for day-to-day living. Usually teachers ignore the background of the children and teach concepts of counting, sorting, ordering, and measuring in an abstract manner.

Turner (1989) further asserted that by using activities such as indigenous games and rhythm--activities in which children naturally and spontaneously participate in--the teacher will be tapping the child's most important source of motivation, which is interest.

Table 6

Use of Other (Commercial) Games in Mathematics Teaching and the Years of Teaching Experience

USE OF GAMES	Frequency of responses				
	under 5	5-9	10-14	15-19	20+
More than once	36	39	16	12	14
Not used	11	4	4	3	5
TOTAL	**47**	**43**	**20**	**15**	**19**

$\chi^2 = 3.937$, $df = 4$, $p > 0.05$

Table 7

Use of Other (Commercial) Games in Mathematics Teaching and Teachers' Qualifications

USE OF GAMES	Frequency of responses				
	PTC	ATC	ETC	PLC	Others
More than once	97	1	15	2	1
Not used	20	0	6	1	0
TOTAL	**117**	**1**	**21**	**3**	**1**

$\chi^2 = 2.406$, df = 4, $p > 0.05$

Once the child's interest has been captured, learning becomes a meaningful experience. Furthermore, teaching mathematics through indigenous games bridges the gap between children's culture and that of mathematics.

Traditional games can be categorized by the way or the reasons they are played (Opie & Opie, 1969). Thus we have chasing and running games, counting games, strategy games, central person with(out) power games, measuring games, and rope skipping games.

Games in table 8 fall into one or more of these categories. 'Dibeke" is a running, chasing, and counting game. It involves two teams: the fielding group and the players. The players dodge the ball and count to a certain number agreed upon by the groups. The fielders try to tag the players with a ball. If all the players are tagged with a ball, they are out, and they have to field. The game may be used to teach counting, targeting and timing, and four operations. 39.3% of the respondents use the game for number operations, and 29.0% use it for teaching counting.

'Nonyane tse tlhano', 'Ntshala morago', Peba le Katse' 'Terena', and 'Koi' are chanting and singing games. 'Nonyane tse tlhano' may be used to enhance the teaching of counting, number operation and multiples of five. Children sing and act out their singing; subtracting, adding or multiplying numbers. 54.5% of the respondents use it for teaching number operations, and 27.0% use it for counting.

In 'Ntshala morago' (Follow) game children do what the leader does and says. It helps children to develop listening skills. The leader gives instructions and each player has to follow, failing which the player is out of the game. 17.2% of the respondents use it for number operations and 15.2% in other subjects.

'Peba le Katse' is a chasing as well as a circle game. The cat (katse) chases the rat (peba). Two children act as the cat and the rat; the rest of the class make a circle with enough space in between each pair for the chase. 17.2% of the respondents used it for number operations; 9.0% use it in other subjects, and 8.3% use it for counting.

Table 8

Topics of Integration, Reasons for Using Games, Teachers' Frequencies, and Percentages of Responses

Game	Teachers indicating v. often & often	Topic(s) of integration	Reason(s) for using the game
Dibeke	117 (80.7%)	Number operation 57 (39.3%)	Introduction 79 (54.5%)
		Counting 47 (29.0%)	Lesson Review 13 (9.0%)
Nonyane tse tlhano	110 (75.9%)	Number operation 79 (54.5%0	Introduction 92 (63.4%)
		Counting 40 (27.6%)	
Tshwara molekane	108 (74.5%)	Number operation 57 (39.3%)	Introduction 74 (51.0%)
		Counting 17 (11.7%)	
		Measurement 15 (10.3%)	
Morabaraba	106 (73.2%)	Number operation 96 (66.2%)	Introduction 88 (60.7%)
		Counting 33 (22.8%)	Lesson review 14 (9.7%)
Ntshala morago	104 (71.7%)	Number operation 25 (17.2%)	Introduction 44 (30.3%)
		Other subjects 22 (15.2%)	
Diketo	104 (71.7%)	Number operation 105 (72.4%)	Introduction 97 (65.5%)
		Counting 18 (12.4%)	Lesson review 11 (7.6%)

(Table Continues)

Game	Teachers indicating v. often & often	Topic(s) of integration	Reason(s) for using the game
Terena	102 (70.3%)	Number operation 78 (53.8%)	Introduction 70 (48.3%)
		Counting 14 9.7%)	Lesson review 15 (10.3%)
Peba le Katse	101 (69.6%)	Number operation 25 (17.2%)	Introduction 52 (35.9%)
		Other subjects 13 (9.0%)	
		Counting 12 (8.3%)	
Lotshitshi la noka	100 (68.9%)	Number operation 62 (42.8%)	Introduction 60 (41.4%)
		Counting 15 (10.3%)	Lesson review 12 (8.3%)
		Other subjects 12 (8.3%)	
Foranse Skipping	93 (64.2%)	Number operation 23 (15.9%)	Introduction 61 (42.1%)
		Counting 38 (26.2%)	
		Measurement 20 (13.8%)	
Koi	86 (59.3%)	Counting 67 (46.2%)	Introduction 78 (53.8%)
		Number operation 23 (15.9%)	
Mhele	86 (59.3%)	Number operation 75 (51.7%)	Introduction 71 (49.0%)
		Counting 18 (12.4%)	Lesson review 13 (9.0%)

'Terena' is a chanting and imitating game. The leader shouts the word 'terena' (train), and the rest of the group imitate the sound of the train. The game may be used to enhance the learning and teaching of straight and curved lines. It may also be used in number operations and counting. 53.8% of the respondents use the game for number operations, and 9.0% use it for counting.

'Koi' is a rope-skipping game. The rope is held at the ends by two people; they swing the rope up and down, chanting some words. The player must be able to count and also to estimate the height of the rope. The game may enhance the teaching of measurement and estimation. 46.2% of the respondents use it for counting, and 15.9% use it for number operations.

'Lotshitshi la noka' (River Bank) is an acting game whereby the central person gives orders. The game is about the river and the bank. Players have to be at an announced position, inside the river or on its bank. The game may teach directed numbers, counting, straight lines, and number operations. 42.8% of the respondents used the game for number operations, 10.3% for counting, and 8.3% for teaching other subjects.

'Foranse' skipping is a rope game. A knot is made so that the rope forms an enclosure. Two people hold it in such a way that it makes an oblong shape. The player jumps inside then outside the rope. The first length is knee length, then thigh length. The next length is the waist, the armpit, neck length, and finally the head length. In these different lengths the player starts running and pacing from different positions. The game may be used for measurement, ordering, sorting, counting, estimating, and geometry. 26.2% of the respondents use it for counting, 15.9% for number operations, and 13.8% for measurement.

'Diketo' and 'Morabaraba' are counting games. Both games are played on the board or cup-like shaped hole dug in the ground. 'Diketo' uses 10 pebbles which are put into a cup-like hole about 5 centimeters deep and 10 centimeters wide. The pebbles are removed from the hole, then put back into the hole; first one by one, then in twos, then in threes, and so forth. Each time, the eleventh pebble is thrown into the air; the goal is to remove all the pebbles from the hole, and then catch the thrown pebble before it falls. If the player misses one of the pebbles, she or he is out. The game may enhance counting, multiples of numbers from 2 to 10 and number operations. 72.4% of the respondents use it for number operations, 12.4% for counting.

'Morabaraba' game is played on twelve holes dug from the ground or drawn on the board. Six holes are for one player who has 12 pebbles to play with. The rules of this game are more or less the same as Mancala game (Culin, 1971). Two pebbles are put into each of the twelve holes. To start the game the first player takes the pebbles from any of his or her holes, then puts each pebble in each hole in an counter-clockwise direction. This continues until the player drops the pebble in an empty hole on his side. Then it is his or her opponent's turn. If he or she drops the pebble in the empty hole on side of his or her opponent's side, he or she confiscates the opponent's pebbles opposite the empty hole. The game continues until one player has confiscated all of his or her opponent's pebbles--which are regarded as cattle. (Batswana are a cattle society, and historically a rich man is the one with many beasts.)

Mancala is an Arabic word which means transferring (Culin, 1971). Indeed, in this game the pebbles are transferred from one hole to another in an counter-clockwise direction. The game can teach directed numbers, counting, number operations, and multiples of two. 66.2% of the respondents used it for number operations, and 22.8% use it for counting.

'Mhele' is a three-in-a-row game which enhances spatial thinking. It is played on a board, or a diagram may be drawn on the ground. It is played on 24 positions. Players have twelve pebbles each. The aim of the game is to make a line of three pebbles (called mhele) horizontally, vertically, or diagonally. When this is achieved the player has to confiscate one of the opponent's pebbles. The game is over when one of the players has only two pebbles left. Mhele (a line of three pebbles) can be made in twenty different positions. The game may teach geometry, number operations, counting and multiples of three. 51.9% of the respondents used it for teaching number operations, and 12.4% use it for counting.

Table 8 does not contain games that have a frequency of less than 59%. They are 'Khupelekhupele (29.0%), 'Sekotshe' (32.9%), 'Banyana banyana' (40.6%), 'Ke ka go kitla' (36.5%), 'Nxai' (14.4%), 'Boleke ba mmampatile' (11.0%), 'Dila' (25.5%), 'Thini tse tharo' (24.2%), 'Diphiri' 16.5%), and 'Dinkunku' (13.8%).

Topics of Integration. The topics of integration included number operations, measurement, sets, counting, probability, geometry, and problem solving. The number operations category included addition, subtraction, division, multiplication, place value and mental arithmetic. The counting category included counting, number line, and directions. According to teachers, these topics have the same objectives as some of the traditional games.

Modes of Use. The most common modes of use of games were in lesson development, lesson introduction, lesson conclusion, lesson and demonstration and presentation. In data preparation all the above modes were classified under the heading *Lesson Introduction*. The next common classification was *Lesson Review* which included skill practice and memorization, lesson activity, evaluation, and feedback. Other reasons for using the games included remedial purposes, lesson enrichment, extension or reinforcement, teaching problem solving techniques, and teaching language skills. Teachers also indicated that they use games to arouse learners' interest so as to enable them to perform better.

These modes of use are similar to the results obtained by Klann (1980) in his study on the use of (commercial) games in chemistry teaching. He was working with Grade 10 chemistry teachers, Edmonton.

Mathematical Concepts in Mhele. Table 9 shows the extent of teachers' awareness of the utilization of concepts found in mhele; Table 10 shows the skills that teachers thought could be learned from playing mhele game. Table 11 shows teachers' suggestions on how mhele could be modified to suit their teaching and children's learning situations.

Geometry was the most commonly known concept in mhele (49.7% of the respondents). Number operations were second, with 40.0% of the responses. Teachers (47.6%) believed that in playing mhele, problem-solving techniques are learned and practiced (see Table 10). Teachers (37.2%) also indicated that communication and spatial skills are learned as the game progresses, probably because the players have to plan ahead as they begin to play.

Game Modification. Mhele is a three-in-a-row game, one of the versions of tic-tac-toe. It is like Twelve Man's Morris played by British colonists in New England (Zaslavsky, 1982). Both games have 24 playing positions though they have different diagrams. In mhele, corners of the diagram are connected to each other. A similar game, Mølle, is played in Norway with slight variations in the rules. This variation was noted by Zaslavsky when she said that as a game travels in time and space, the rules usually change.

Teachers also indicated the possibility of having variations in games: 17.9% of them indicated that they would modify the mhele diagram to suit their teaching situation; 13.8% indicated that they would change the rules of the game, and a further 13.1% of respondents said they would use the diagram as a teaching aid; 15.2% did not see any need for game modification (see Table 11).

Table 9

Identification of concepts found in Mhele game by teachers

Concepts found in mhele diagram	No. of teachers	% of responses
Number operations	58	40
Counting	13	9
Geometry	72	49.7
Measurement	11	8
Number theory	21	14.5
Sets	6	4
Problem solving	4	3
TOTAL	**185**	**128.2 ***

* Respondents could choose more than one response.

Table 10

Identification of Skills learned from playing Mhele game by teachers

Skills learned from playing mhele	No. of teachers	& of responses
Number Operation	39	26.9
Problem solving	69	47.6
Counting	31	21.4
Communication	54	37.2
Measurement	22	15.2
TOTAL	**193**	**148.5 ***

* Respondents could choose more than one response

Those who suggested diagram modification suggested decreasing the lines so that young children might be able to comprehend. For instance, an equilateral triangle with median lines, or a square with lines of symmetry might be used (see Figures 2 & 3). This kind of modification also affects the rules of the game. Each player could have three pebbles instead of twelve.

Modifying the rules also implies modifying the diagram. Most teachers suggested either increasing or reducing the number of pebbles, which has a direct impact on the complexity of the diagram.

Another category of game modification included using the diagram as a teaching aid. Teachers suggested that the diagram could be useful when teaching line symmetry, sloping, vertical and horizontal lines, and shapes. They indicated that the diagram has different shapes such as triangles, squares, trapezium, and rectangles.

Other Versions of Three-in-a-Row Games

Three-in-a-row games are played throughout the world; for example in England, Sweden, Sri Lanka, Southern Africa, and Norway. Each country has its own version and name but they all are played on crafted boards or diagrams traced on earth. They are skill games and are often played by males except in Sri Lanka where Nerenchi is played by girls and women.

These three-in-a-row games have a long history: A Mølle diagram was found crafted on the wooden planks of the Viking ship, and Nerenchi is at least 200 years old. The game can be used to teach addition, subtraction, number theory, and patterns. The board could be drawn on a square paper and used as a teaching aid to teach geometry: cartesian coordinates, parallel, and intersecting lines. The game can be modified to suit any grade level, from Grade 1 to Grade 12. The game would change in its complexity of strategy if used by the students in the upper level.

Table 11

Teachers' Suggestions on modifying mhele game to suit teaching/learning situation

Game Modification	No. of teachers	% of responses
Diagram	26	17.9
Rules	20	13.8
Teaching aid	19	13.1
No need for modification	22	15.2
TOTAL	87	60

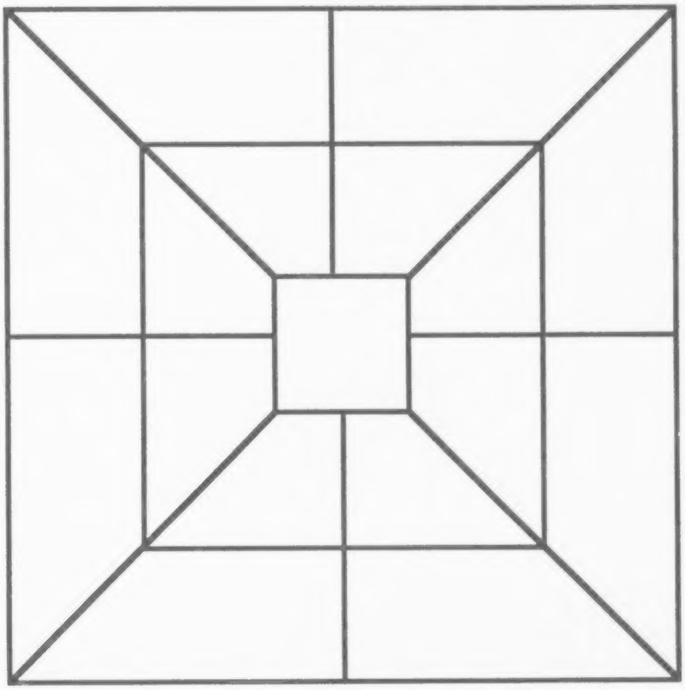


Figure 2. Mhele diagram

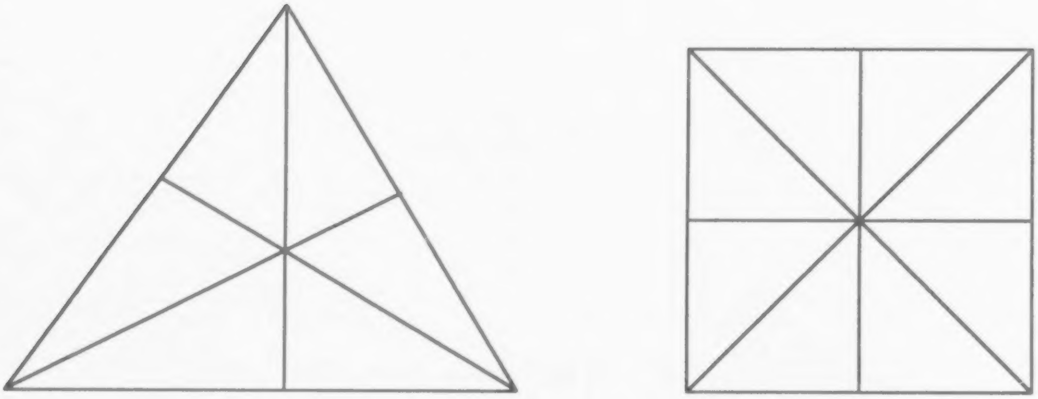


Figure 3. Modified mhele diagrams

Summary of Questionnaire Results

A total of 145 teachers, 91.7% of whom were females who were teaching standard two or three in 1993 in Central District, Botswana, participated in the study. Out of these, 76 (52.4%) were standard two teachers, and 69 (47.6%) were standard three teachers. 51.3% of standard two and 62.3% of standard three teachers reported using cultural games in the teaching of mathematics. 32.4% of teachers were on the teaching field for less than five years, and 77.2% of the participants have been teaching Grade two or Grade three for less than five years.

There was no relationship between the use of traditional games and the following variables: teacher's qualification and years of teaching experience, and the use of cultural games.

About 80% of the teachers spoke of using games. Of these 80.7% who used pre-prepared commercial games, only a sub-group (56.6% of the total) also used cultural games. The results of the study also show that teachers do not exchange ideas; they use learners' ideas instead.

Most teachers (82.1%) use games in teaching social studies. Other subjects of integration are English (75.9%), Setswana (74.5%), Science (53.8%), religious education (52.4%), agriculture (43.4%), and art (53.1%).

Dibeke was the commonly used game in mathematics teaching, followed by 'nonyane tse tlhano'. 'Mhele' and 'koi' were the least used games. However, teachers were able to indicate valuable aspects in mhele. Geometry is one of the concepts teachers see in the mhele diagram and playing the game helps in developing problem-solving techniques. Most teachers believe that playing mhele develops the players' spatial and problem-solving skills. This tallies with the results of the study in Lesotho, where primary school teachers observed that students who know and have played the game were good in their geometry classes (Zaslavasky, 1982).

Interview Schedule Results

The potential participants for the interview schedule were selected according to their questionnaire responses.

Among the ten that were interviewed two had less than 5 years of teaching experience, three had more than 20 years of teaching experience, and five had more than 10 but less than 20 years of teaching experience. They hold PTC (6), ATC (1), and PHC (3) certificates as their highest academic qualification, respectively.

All the interviewees indicated some advantages and disadvantages of using the games in teaching. The advantages of using games in the classroom included arousing learners' interests; providing a relaxed and non threatening atmosphere; and moving from known to the unknown. Teachers mentioned the merits of starting the lesson with what the children already knew, and then building on that. However, teachers indicated that using games in the classroom instruction demands more time for proper preparation.

Teachers indicated that they have used games more often in other subjects than in mathematics because it is easier and less demanding to do so. In social studies, for instance, teachers use games and play songs to teach children culture, and that makes their teaching much easier. They added that if it were possible, they would prefer to have something written to guide them in using these games in mathematics teaching, as is the case with other subjects.

The data from the instrument are now discussed question by question.

Question 1

Do you know any traditional games that Batswana children engage in before coming to school and during their school age?

All the interviewees claimed to know morabaraba, mhele, diketo, and koi. Thirty percent of them knew nxai; another thirty percent knew Foranse skipping game. Other games mentioned were dibeke, khupekhupele, boleke ba mmampatile, monna yo montsho, terena, peba le katse, phoi maeba, dinkunku, and tshetshe. It must be noted that even though the list is short, it does not imply that teachers did not know other games. As some of them commented, "they are many; it would take us long to complete the list".

Question 2

Do you use these games in the teaching of mathematics? If so, what is the reaction of the learners when using games? How is their interaction affected by the games?

Of the ten interviewees, one claimed not to have used these games in the teaching of mathematics, but she often uses them in physical education and social studies. Other teachers claimed to have used mhele, morabaraba, and diketo in teaching counting, addition, subtraction, division and multiplication. Otherwise, they use most of the games in other subjects. "I use diketo and others especially in social studies showing them [students] the things of old--showing them their culture" (T9).

Commenting on the reaction of the learners, all the interviewees mentioned that children become interested in their work. Even slow learners are aroused to participate in the class. One teacher said: "When you are using games in classroom teaching, even the slow learners become more interested as compared to the use of the lecture method" (T3).

Question 3

How do you compare traditional games with the commercial ones? What is the children's involvement in each case?

Most of the interviewees (80%) believed that using cultural games has more advantages over commercial games because the children are familiar with the former. Time is not wasted on rehearsing the rules of the games. Instead, it is spent on learning the concepts.

In the case of commercial games children are interested in the materials used. As a result they like to manipulate and experiment with these materials, which ultimately results in desirable learning. However, because children are to learn the rules first, much time is consumed when using Western games than traditional ones. To emphasize this point two teachers said;

> When using cultural ones [games] at least everyone knows what you are talking about even the slow ones, as contrasted to the commercial games. (T3)
>
> Children do understand quickly and easily when using cultural games. This is because children come to school already knowing them [cultural games]. You do not guide them much ... whereas with these other ones [commercial games] you have to spend time guiding them. (T 4)

This comment shows that teachers use commercial games not because they are better than cultural games, but because they have pre-prepared materials.

Question 4

What mathematical ideas do children get when playing these cultural games? How do you know that the learners have got these concepts from the game? And what do you do to help children use such concepts in learning other topics?

The following were mentioned as the concepts learned from playing the traditional games: addition, subtraction, multiplication, measurement, geometry (shapes, lines of symmetry, number line), probability, problem solving, sets, and counting. Teachers indicated that they would know if their children have learned any concept through evaluation. They would ask them questions, give them some written work to check if they understood. More work is given as homework, where children are asked to relate what they were doing (that is, the games they were playing) during the day.

Commenting on how they help learners use the concepts obtained from playing games, T1 said:

> After using the games, we use numbers instead of pebbles. When I ask them to move either forward or backwards a certain number of steps, they would refer to the game, thus using the skills they have learned from playing the game. Therefore learners always refer to games when doing classroom work.

Similarly T2 said:

> After playing games I question them so that they see the relationship [between concepts found in games and classroom mathematics]. However, sometimes children lead me. That is, they tell me how to use concepts learned from games in mathematics topics.

Other teachers have indicated that they tell children to make connections while playing; for instance, counting in twos while playing diketo.

Question 5

When children are playing there is bound to be a lot of noise. How do you handle playing and learning at the same time?

Some teachers said they use various games to teach one concept. This is done by forming learning centers in the classroom. Various groups of students visit these centers at different times, and as a result the noise from their discussions does not disturb classes nearby. Some prefer to take the children to an open space so that other classes will not be disturbed. Still others said that to control the noise they keep an eye on the students and move around to control the working groups. This is the only place where teachers have indicated that when using games they put students in small groups.

Question 6

Most people believe that learning cannot take place in play situations. What is your response to that?

Teachers did not deny the existence of the claim that learning cannot take place in playing. They harbored the fear that if games could 'seriously' be used in classroom instruction, parents would complain. This fear has no roots in the people's culture. Parents, to the contrary, do encourage their children to be engaged in games when there is no 'work' to be done, and they believe that it is through simulation games that children learn about adulthood. This is explicitly stated in the statement *Mmamotse o bonwa* *mantlwaneng* a tswana proverb which means "the little girl who would be a successful homemaker reveals her traits in home life [simulation] plays". Parents could tell which child is going to be a good citizen when watching their children playing.

However, teachers believe that when traditional games are integrated in classroom teaching, learning will be ensured: "Those who complain have not noticed that children learn better during play. They have not discovered that children score higher marks when play activities are incorporated in the classroom activities" (T2).

Still emphasizing the benefits of using games as opposed to the lecture method, T5 said:

> It is not true. I know people believe that children do not learn a thing when playing. This is not true because when using games in classroom instruction almost all the children, I repeat, almost all get involved. Whereas, ... after using the lecture method ... children are not eager to do work. When they are asked to write they become busy with their own things. But as for the method of using games, everyone likes to participate.

Also teachers pointed out that games help them know and observe children as individuals. Children who seem not to like participating in class activities end up having better evaluations through the use of games. Ainley (1986) argued that during play children's thoughts are more transparent. Their actions reveal their thinking and working strategies, and this gives teachers an opportunity to ask them questions which would explain their thoughts.

Question 7

What attitudes do your colleagues and the headmaster show towards your style of teaching?

Teachers indicated that incorporating games into the curriculum has proved to be better way of teaching young children. As a result their colleagues commended them for their style of teaching instead of scolding them. However, some headmasters are reported to have complained of dirt from the small pebbles on the classroom floors. These headmasters are inclined to favor commercial games because their materials would not leave any dirt. Teachers interviewed indicated that those headmasters or their colleagues who might otherwise not be happy about the integration of games in the classroom are the educators who believe that abstraction is better education.

The interviewees did not overlook the point that games may be misused in teaching. As T4 said, "when used accordingly ... a game is very important. However, it is bad if the game is not used in a beneficial way".

Question 8

Do you have any comments regarding the possibility of having these traditional games in the mathematics curriculum?

This question gave teachers an opportunity to air their views on mathematics instruction in general. They commented on the advantages that games bring to teaching situations. Amongst these are that teachers are able to see the strengths and weaknesses of their children; that children become active participants in their learning; that children also interact with each other freely, seeking help from the brilliant ones.

Commenting on why games should be included in the curriculum, T10 said:

> To me the curriculum which suggests the use of games is very good. Games help learners to understand difficult concepts which they would otherwise not be able to cope with. By using cultural games you move from the known to unknown, moving from an appropriate level to the next level of difficulty. That is why children participate: They are not alienated from the lesson. The slow learners have an advantage. They talk, participate, and socialize during play.

Another category of comments on inclusion of games in the mathematics curriculum was the compilation of traditional games into a booklet which could be accessible to teachers (T2, T4, T6, T7 and T8). They mentioned that being familiar with the name of the game does not mean knowing the rules of the game, and if there were "someone who can write up the rules, ... it could be good to have them in the curriculum (T6). Other teachers felt that these games could be used in the entire Nine - Year Curriculum, not only at primary school level:

> This is how I look at it, that cultural games be used not only at a certain grade. As we use them in standard one, they must also be used in higher grades according to the level of the grade--suitable for the grade. Games must be developed according to the ability of the learners (T4).

Summary of Interview Results

The data from the interview schedule has shown that teachers integrate games in the teaching of mathematics but not as much as in the other subjects. Social studies, English, Setswana, and physical education seem to be the prominent areas where cultural games are used. This may be because teachers have guidelines as to how they can use these games in such areas.

Outdoor games are played in an open area where the noise from the players will not disturb other classes, while indoor playing needs to be supervised thoroughly to minimize the noise. Sometimes various games are used in one setting so that individuals in the group will not have to talk aloud in their discussions.

Teachers use cultural games to enhance the teaching of measurement, geometry, probability, sets, integers, and numbers operations. The most popular use of these games is during lesson introduction and lesson conclusion. Sometimes remedial lessons are given to students who seem to have some difficulties. These modes of use are similar to the results of the study conducted by Klann (1980) in Edmonton on using games in chemistry teaching.

Games are said to improve achievement scores, motivate the learners to actively be involved in their learning, and facilitate student evaluation. To make sure that learners have gained something from the games, teachers ask them questions in relation to what they were doing, and give them homework on the concepts learned. This exercise facilitates the transfer of learning concepts from the game to learning other topics in the syllabus.

Teachers in this study reported that some cultural games used in social settings are for boys, others for girls, and a few for both. Those which are believed to develop spatial abilities such as mhele, morabaraba, and nxai are said to belong to boys; koi, diketo, 'Foranse' skipping and 'khupekhuple' are for counting and chance, and they are played mostly by girls. However, when using these games in the classroom, teachers reported that both sexes participate equally.

The names of games mentioned by the interviewees closely matches the list provided in the questionnaire (question II), where participants were asked to indicate the extent to which they use the games.

Chapter Summary

The interview and the questionnaire results show that the majority of teachers use cultural games in the teaching of social studies. Not much is done in mathematics instruction.

The modes of use include lesson introduction, development and conclusion; practice and drill of content, skill development, remedial and lesson enrichment, motivation and concentration, and evaluation. This list matches the results of the study by Klann (1980), in which chemistry teachers were asked to indicate how they used (commercial) games. The interview and questionnaire data complemented each other.

CHAPTER V

STUDY SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

This study concerned itself with the possibilities of using cultural games in mathematics teaching in primary schools in Botswana. Evidence has been gathered from the described, varied sample of possibly interested teachers about their use of games and potential for such use. The chapter thus provides the study summary and also discusses the study conclusions, implications, and recommendations for future research. The chapter also looks at the dichotomy between work and play, how it affects the classroom environment, and its implication for classroom practice.

Summary of Procedures and Findings

The intent of the study was to find out the extent to which standard two and standard three teachers use traditional games in mathematics teaching. The literature on the use of games in mathematics education had pointed out that there are notable rewards in integrating games in mathematics and other subjects. However, none of these studies were on the integration of cultural games in mathematics teaching.

Anthropological studies on traditional games have shown that children engage in societal games at an early age, and that by so doing they are exposed to rhythms and finger counting, for instance, before they come to school. The literature also shows that the representation of some games is an indication of how people in that society represent numbers and carry out their counting (Gerdes et al., 1993). Conclusions from such studies suggest that before and outside school almost all children from all over the world develop the capacity to use numbers and measure quantities (Gerdes 1993). This further indicates that every child has a mind for mathematics provided that the mathematics is presented in an understandable way (Zaslavsky, 1982); that is, when it is presented at level of understanding of the children involved in learning. Often children do not connect symbols used in formal mathematics to their own informal knowledge of numbers. This may be why they find school mathematics difficult (Baroody et al., 1990).

Five research questions provided the focus for the investigation into the use of cultural games in the teaching of mathematics in lower primary levels. A questionnaire and the interview schedule were developed to gather data. Ten teachers were interviewed, and questionnaires were either sent or delivered to 200 standard two and standard three teachers of Central District, Botswana. 145 questionnaires were completed and returned providing a 72.5% response. Three questionnaires arrived late and were not included in the data analysis. Out of 145 who returned questionnaires, 76 (52.4%) were standard two teachers, and 69 (47.6%) were standard three teachers.

The first research question inquired about the extent to which teachers used games in their classroom instruction. In particular, the researcher wanted to know how much and how often traditional games are integrated in mathematics teaching. The second question had a curriculum aim, seeking the specific mathematics topics in which traditional games are used and the purpose of using such games in mathematics teaching. Topics of integration included number operations, measurement, sets, counting, probability, geometry, and problem solving. In terms of curriculum and instruction at a lesson level, teachers used games to introduce a lesson, to teach new concepts, in lesson demonstration, in remedial lessons and in lesson presentations.

The third question was on how teachers actually integrate these games, how they make sure that children learn mathematics concepts from playing games. This in-depth analysis of how teachers use traditional games was done through the use of an interview schedule with a smaller number of teachers (10).

The fourth research question was about a particular game, 'mhele'. The questionnaire provided the opportunity for teachers to show the depth and specificity of their practical understanding of use of the cultural games in teaching mathematics.

Teachers were to pinpoint the mathematical concepts and skills gained from playing the game. The participants were also given the opportunity to suggest how the game could be modified to suit various learning situations.

As a practical matter, it is useful to see if teachers with different educational backgrounds and experience react differently to game use in the classroom. Therefore, the last question sought to determine the relationship between the use of cultural games and (a) teacher's qualifications, and (b) teachers' years of teaching experience. Using appropriate statistical methods, it was found that there was no relationship between teachers' qualifications teacher's years of teaching experience, and their use of cultural games.

A total of 82 (56.6%) teachers (39 grade 2 teachers and 43 grade 3 teachers) claimed to have used cultural games in mathematics teaching.

Conclusions and Implications

The conclusions drawn are supported by the explicit and implicit content of the findings reported in chapter IV. These conclusions, combined with a discussion of their implications, are in a sense the essence of the study and are often suggestive of areas in mathematics teaching, teaching methodologies, and teacher education needing further exploration. The problem of integrating cultural activities into mathematics instruction is ongoing; therefore, the conclusions reached by the study will be reviewed and reconsidered in the light of future studies.

1. Teachers did not use traditional games (in mathematics teaching) to a great extent. But in the survey results they reported having used these games in mathematics teaching. However, during the interview schedule teachers indicated that such use was often minimal or less informed than it might be; they wanted some guidelines on how to use the games in mathematics teaching. This finding suggested that teachers might not be using games in mathematics, but rather in other subjects where they have such guidance.

2. Whenever traditional games were used, teachers separated the venues for 'work' and 'play', thus separating play context from work context. Often times children are taken outside the classroom for play activities and thereafter taken back into the classroom for discussion. (The researcher witnessed this in one school where a standard one teacher had taken her class to play diketo.) However, this method may fail to allow the children to realize the importance of play in their learning. The notion that play is a frivolous, fun, and non-serious activity may be reinforced in their minds.

Furthermore, children may not see the connection between what they were doing in the game on the playground and what the teacher wants them do in the classroom. This phenomenon of separation is known as the dichotomy between work and play, and it is discussed in paragraphs below.

Dichotomy Between Work and Play and its Implication for Classroom Teaching

Play is defined as joyful, spiritual, frivolous, and fun. On the other hand, work is taken to be serious, important, and focused on reality. Children start playing in their earliest days perhaps even before birth. However, their first "work place" often comes at school. Parents, teachers, and children identify the educational activities as work. Although play activities may be found at school, the way teachers relate to these activities differs from the way they relate to work activities. The two activities are categorized according to the power of either teachers or children. Play activities are considered to be voluntary and self-directed, while work activities are teacher-directed. This dichotomy has some implications for classroom practice.

King (1983) asserted that the role of the teacher, children's interactions, and children's relationship to classroom materials change from work contexts to play contexts. Teachers are instructors, leaders, supervisors, motivators, and evaluators during work time. During play time they are facilitators, providers, observers, and listeners. In this study, teachers reported that they take children to an open area whenever it is play time and to observe them as they play, after which they go back into the classroom for discussions. During this play time children are free to choose their games and those with whom they want to interact. But during school work time children are directed to pre-defined, pre-ordained activities.

During work time children are discouraged from interacting with each other. If they do, such interaction can be labeled cheating, copying, chatting, or disturbing. This attitude of teachers discourages discussions among learners, and children are also at a disadvantage when they cannot get help from their peers. This experience brings harmful effects on children's behavior. However, the interviewees noted that it is good for children to discuss among themselves, and that this often occurs during play sessions. Teachers did not deny that sometimes they discourage children from interacting once they get back into the classroom. This, they said, was to minimize the noise. Commenting on how to change this situation, the interviewees in this research said that it needs a different perspective on education, classroom discipline, and instruction. Such a change in practice suggests that teacher education, pre-service, and in-service are needed on the role, possibilities, and practice related to play and learning.

The way children relate to classroom materials differs from play contexts to work contexts. The use of material shapes the behavior of children. Whereas the use of material is standardized in work activities, during play, materials are tools that children use to construct play activities to achieve their goals. This separation between work and play contexts could be overcome by organizing the curriculum to enhance the exercise of autonomy on the part of children in all learning areas.

By creating environments which deny dichotomy, teachers can have intervals of play and work activities in one lesson. For instance, using diketo to introduce multiplication and/or division of numbers; teachers might prepare a worksheet which the children might fill in while playing. After filling in the first portion the teacher can lead discussions, after which children will continue to play so that they can fill in the next section, after which they would discuss as the whole class. Under such circumstances play and more formal mathematics activity would be more integrated (see Appendix C).

3. Teachers are in need of information regarding the use of traditional games in mathematics teaching. This theme was heard throughout the interviews. T2 said that traditional games have the same teaching potentials as Western games, but she preferred Western games because of their pre-prepared materials. This is a clear indication that a follow-up study is needed in which games suitable for mathematics teaching and their modes of use could be explored.

Teachers' Voices and the Possibility of Using Traditional Games in Mathematics Curriculum

The results of this study show that teachers do use traditional games in teaching. However, a closer analysis of the interview results indicates that most teachers do not use these games to teach mathematics, but rather use them to enhance social studies and Setswana. When asked further about this issue, their response was that it is easier to use these games in social studies because of the availability of guidance. One might suggest that teachers are not against the idea of using traditional games in the curriculum as long as there is some written guidance.

A typical class enrollment is 45, and technically teachers should to know and treat each child as an individual. This means putting a lot of time and effort into preparation. Asking teachers to integrate traditional games would involve extra work on their part. They would have to think about how to do it, how they should modify rules or materials, and about how to make connections between the topic and the game. Some of the respondents felt that this point is important. The implementation of this argument is that a small or reasonable number of children per class might enhance teaching and learning situations as well as classroom discipline.

4. The fourth conclusion is that the use of cultural games in mathematics teaching is related either to years of teaching experience or to education. This conclusion assumes that the availability of knowledge about traditional games, rules, and modes of use does not guarantee that either a long-service teacher or a qualified teacher would integrate it into classroom instruction. However, the attitudes of the interviewees reacted positively towards using these games in mathematics teaching in the future.

Attitudes of Teachers Towards Curriculum Innovation

Even though teachers have mentioned possible problems when using traditional games, their attitudes towards curriculum change were positive. They advised that if the Ministry of Education seriously wants the integration of traditional games, workshops on how these games could be used should be conducted throughout the country. They were willing to be involved in case studies which could help identify cultural games suitable for mathematics teaching.

5. The use of cultural games in classroom instruction does not impose a 'new' style of teaching on teachers. Teachers in this study thought that using games in teaching mathematics was not an idea alien to their present practice. Some interviewees made some links between the Breakthrough Method and using cultural games. They further commented that they needed someone to raise their awareness on how to improve the modes of use for these games. This has some implications for teacher education. Mathematics educators at Teacher Training Colleges might have to help their student teachers see the pedagogical importance of traditional games.

Study Implications for the Curriculum, Teacher Education, and Instructional Methods

Teachers have indicated that they are using games in the same way that they use the Breakthrough Method. During the breakthrough lesson, the class is divided into groups of different abilities. These groups are engaged in various tasks at the same time. In the same manner some teachers have said that they make various learning centers in their classrooms when using games so that different groups may do various activities simultaneously. It could be useful for Teacher Training Colleges to emphasized skills in handling different groups of learners in the same lesson. This would help teachers to provide not only for the appropriate level of content and learning style (pace) for example, but also an opportunity for each child to be actively involved in her or his learning through discussion. Usually small groups give an ample opportunity for free talk.

Furthermore, these small groups could be groups engaged in mathematics projects. Katz and Chard (1989) and Jones et al (1983b) have argued that the topics of the project should come from the children's environment. Children should be given the opportunity to discuss what they are familiar with, things that constitute their everyday lives. Cultural games are one of the elements that make up the child's environment. The learners may choose a particular game and discuss how it can enhance various mathematics topics. As children discuss their methods of solving problems the teacher is able to evaluate them. Their thoughts become transparent to the teacher, and she or he is in a position to know if children have understood the concepts.

During the implication of the Project Method it was reported that there were problems such as division of time between the projects and teaching basic skills, planning and preparation which reflect children's point of view. These problems may be encountered when games are used. As mentioned earlier, teacher educators have an agenda to attend to: emphasizing innovative instructional methods influenced by current research.

From the literature review it is evident that children come to school already knowing how to count, weigh, sort and order. They learn these concepts and others such as probability and geometry from playing traditional games. They learn repeated addition; for example, when playing the 'diketo' game the player starts the game by adding one until she or he reaches ten (10). That is, 1+1+1+1+1+1+1+1+1+1, and then adding two: 2+2+2+2+2 then 3+3+3+1, etc.

This has some positive implications for curriculum. Probably not much time may be spent in some areas of the standard one mathematics curriculum, especially concepts involving addition, because children experience such concepts in their play activities (Kamii & DeClark 1985). Furthermore, teachers could employ methods similar to the way children obtain their informal knowledge about arithmetic.

It could be a useful idea to research more on cultural games so that some guidance might be provided on how to integrate them in teaching mathematics. These guidelines might contain rules of each game and suggestions on how it could be modified to suit a particular learning situation. Also, materials for these games could be developed and kept handy for use. For instance, 'mhele' could be carved on a wooden board and stored as a class set. This could solve the problem of messing up the classroom floors.

Suggestions for Further Research

1. According to the results of the study, some of the games were not used as frequently as others. In this case one might think that children have lost interest in these games (Opie & Opie, 1969). However, another perspective could be that these games are not good for teaching mathematics. It is important therefore that a case study be conducted as a follow up to the present study to find out which games are suitable for mathematics teaching, and which ones are not.

2. Comoe-Krou (1986) argued that teachers should know children's games so that they might use them in classroom teaching. Teachers in this study have indicated that they do not know the rules of most of the games though they may be familiar with the names. Therefore documenting traditional games, will contribute to teachers' knowledge of activities which can interest children in the teaching and learning situation.

Documentation of these games will also contribute to the literature of African folklore. Furthermore, it will keep the culture from dying. In cities and big villages there is a conflict of culture to the extent that children who are born and raised in such places may grow up not knowing traditional games. Documenting these games will benefit such children.

Further still, Opie and Opie (1969) argued that children stop playing their street games at an earlier age than before because of organized sports games and the advance of technology. This was shown in their study of children in England. A study on how far this is true about Batswana children would be of use to both teachers and curriculum developers.

3. Teachers have indicated that they use cultural games for lesson introduction, lesson development, lesson conclusion, remedial or individualized lesson and practice of content and motivation. Perhaps if these uses could be studied carefully with a sample of teachers from the whole country, a reasonable understanding of exactly how cultural games could be used in the classroom would be available for teachers.

4. Apart from group organized games, children in Africa (and elsewhere in the world) have some play activities such as toys: wire cars, donkey carts, bicycles, and cloth dolls. A closer look at how these children make these toys would be a rich source of knowledge for the cognition development of African children.

Moreover, comparative studies have been conducted on children of developing countries with materials and concepts with which they are not familiar. This may be the reason why most of the time, if not always, they are found to be below their Western counterparts. I believe that an opportunity to study these children's activities will provide knowledge about their cognitive development because the literature showed that culture and cognition are somehow related (D' Ambrosio, 1985).

5. Respondents in this study reported that there is gender segregation in cultural games. However, they mentioned that whenever games are used in the classroom, gender divisions are non-existent. It would be interesting to find the extent to which this argument is true. Sutton-Smith (1972) and Ager (1975) have reported that in most of the traditional games children imitate or practice the roles of adult life. That is, girls will imitate motherhood roles, and boys will practice fatherhood roles. It would seem that one sex would be disadvantaged when a game with which they are not familiar is used in the classroom. One possibility could be that imitative games are not used in the classroom; instead, other groups of games such as physical-skill games, games of chance, and games of strategy are used. Therefore, a study is needed which looks at the issue of gender, traditional games and their integration in classroom instruction.

6. Mathematical concepts are not only found in children's games. Adult cultural activities such as floor and wall decoration, earth-pot making and decoration, wooden carved utensil decoration, and basket weaving also have mathematical concepts. Research in this area may not only contribute to the literature of women and development in the country, but could also sensitize women and girls to the fact that, indeed, mathematics is important for everyday living even in African cultural settings. This may encourage more girls to take mathematics courses with enthusiasm.

7. Some literature (Brauer, 1981) has shown that instead of bringing their own creative activities into the classroom, teachers depend heavily on textbooks. Even though they are aware that they have to supplement the textbook they sometimes choose to follow it page by page and chapter by chapter. It could be interesting to undertake a study on how teachers interpret the curriculum and the number of activities they use to supplement recommended materials. This is important to this study because, even if games are compiled and written guidance for using cultural games in mathematics teaching is provided, if teachers choose to follow textbooks page by page, the incorporation of traditional games in the curriculum will continue to be ignored.

8. One of the findings of this study is that few teachers share ideas with their colleagues. The study results show that most teachers (56%) prefer to get ideas from their students. This causes some concern because teachers should share their ideas with each other for their professional development. A study to look at this issue in depth is needed. The study will by and large benefit teacher educators and the Ministry of Education.

REFERENCES

Ager, L. P. (1975). The reflection of cultural values in Eskimo children's games. In Lancy, D. & Tindall (eds.) The anthropological study of play: problems and prospects. Proceedings of the first Annual Meeting of the Association for the Anthropological Study of Play. Cornwall, N. Y.: Leisure Press

Ainley, J. (1988). Playing games and real mathematics. In D. Pimm (eds.) Mathematics, teachers and children. London: Hodder and Stoughton.

Aoki, T. (1990). Inspiring the curriculum. The ATA Magazine. January/February 1990. 37-42

Athey, I. (1974). Piaget, play, and problem solving. Washington DC: National Association of Education of Young Children.

Avedon, E. M. & Sutton-Smith, B. (1971). The study of play. New York: John Wiley & sons.

Backhouse, J., Haggarty, L., Pirie, S., & Stratton, J. (1992). Children, teachers and teaching. Improving the learning of mathematics. London: Heinemann

Baroody, A. J. & Ginsburg, H. P. (1990). Children's mathematical learning: A cognitive view. Journal for Research in Mathematics Education. Monograph number 4. National Council of Mathematics Teachers.

Berg, B. L. (1989). Qualitative research methods for the social sciences. Needham Height: Allyn and Bacon.

Brauer, S. (1981). Chemistry teacher's role in curricula decision making. Unpublished Master of Education thesis. Edmonton. University of Alberta.

British Council (1988). Education in Botswana draft profile. Gaborone: Government Printers

Carpenter, T., Ansel, E., Franke, M., Fenemma, E. & Weisbeck, L. (1993). Models of problem solving: A study of kindergarten children's problem solving processes. Journal for Research in Mathematics Education 24 (5), 428-441

Castle, E.B.(1965) The principles of education for teachers in Africa: The needs for childhood. Nairobi: Oxford University Press.

Charles, R., & Lester, F. (1982). Teaching problem solving: What, why and how. Palo Alto: Dale Seymour.

Cobb, P., Wood, T., & Yackel, E. (1990). Classrooms as learning environments for teachers and researchers. Journal for Research in Mathematics Education. Monograph no. 4. 125-146.

Cockroft, W.H. (1982). Mathematics counts: Report of the committee of inquiry into the teaching of mathematics in schools. London: Her majesty's Stationery Office.

Coles, E. K. T. (1985a). The story of Education in Botswana. Gaborone: Macmillan Botswana.

Coles, E. K. T.(1985b). Education in Botswana. Gaborone: Macmillan Botswana.

Comoe-Krou, B. (1986). The African conception of play and its potentialities for education. Prospects (16) 495-503.

Culin, S. (1971). Mancala, the national game of Africa. In Avedon and Sutton-Smith (eds.), The study of games. New York: John Wiley & Sons,.

D' Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. For the Learning of Mathematics (5) (1). pp. 44-48

Dewey, J. (1933). How we think. A restatement of the relation of reflective thinking to Educative Process. Lexington: D. C. Heath and Company.

Dohler, D. (1963). The role of games, puzzles, and riddles in elementary and mathematics. In Smith and Backman eds. (1992), Games and puzzles for elementary and middle school mathematics. Readings from Arithmetic Teacher. Reston: The National Council of Mathematics Teachers.

Ellis, M. (1973). Why people play. Englewood cliffs: Prentice-Hall.

Ernest, Paul (1986). Games: A rationale for their use in the teaching of mathematics in schools. Mathematics in Schools Vol. 15 (1) p. 2-5.

Evans M. and Yonder (1991). Introduction. Patterns of reform in primary education. The case of Botswana. Gaborone: Macmillan Botswana.

Evans, M, Haseley L. and Leep A (1986). Botswana primary education improvement project number 633-0222 1981-1986 Final Report. USAID/GOB Government Printers: Gaborone.

Evans, M. W. (1985). Botswana teaching competency instruments handbook. Unpublished paper.

Everton, Mayne and White, (1990). Effective learning into a new ERA. London: Jessica Kingslay

Freire, P. (1970). Pedagogy of the oppressed. New York: Continuum.

Gallaghar, P. (1971). Positive classroom performance: Techniques for changing behavior. Denver: Love.

Gerdes, P. (1993). Survey of current work on ethnomathematics. A paper prepared for American for the advancement of science annual meeting.

Gerdes, P., & Cherinda, M. (1993). African systems of numeration. A paper prepared for the UNESCO Courier, Paris.

Gozalo, R. (1991). The effects of Hispanic children's literature on self-esteem of lower socio-economic Mexican-American kindergarten children. Unpublished Jr. Ed. D Thesis. Texas Technology University: Texas.

Haseley, L. (1990). Guide for use with the video tape supervision yesterday and today'. A paper presented at Oasis Motel for PEIP/MoE Conference.

Hoinville, G. , Jowell, R. and Associates (1977). Survey research practice. London: Heinemann.

Horgan, G., Moss, M., Kesupile, A., Maphorisa, J. & Haseley, L. (1991). Towards a child-centered classroom. In Evans and Yonder (eds.). Patterns of reform in primary education. The case of Botswana. Gaborone: Macmillan Botswana.

Hullfish and Smith (1961). Reflective thinking: The method of education. New York: Dodd Mead and Company.

Hunters, E. (1967). Motivation and learning in high school. The High School Journal 50 (7).

ISEA (1985). Breakthrough to Setswana for Botswana teacher's manual. Gaborone: Longman Botswana for ISEA.

Jensvold G. K. (1989). A comparative study of organization of in-service education in Botswana and England. Unpublished study for an advanced Diploma in Educational Administration. University of Leeds: London.

Jones, C., Leeke, J., Leeke, R., & Tarpey, J. (1983a). Guidelines to project methods. A paper prepared for the Ministry of Education, Botswana

Jones, C., Leeke, J., Leeke, R., & Tarpey, J. (1983b). Project approach. A handbook for tutors in teacher training colleges to develop a project approach with students. Unpublished paper.

Kamii, C. & DeClark, G. (1985). Young children reinvent arithmetic: Implications of Piaget's theory. London: Teachers College Press.

Kann, U., Mapolelelo, D., & Nyela, P. (1989). The missing children. Achieving universal education in Botswana. The barriers, and some suggestions for overcoming them. Gaborone: National Institute for Research and Documentation.

Katz, L. and Chard S.(1989). Engaging children's minds: The project approach. Norwood: Albex.

King, N. (1983). Lessons in the meaning of leisure: Understanding the work/play dichotomy. Occasional Paper no. 26. University of Maryland.

Kissane, B. (1986). A mathematical camp. Mathematics in Schools 15(1), pp. 44-46

Klann, H P (1980). Using games for teaching chemistry. M. Ed. Thesis. Edmonton, University of Alberta

Lave. J., Murtough, M., & de la Rocha, O. 1984. The dialectic of arithmetic in grocery shopping. In Lave and Rogoff (eds.) Everyday cognition: Its development in social context. London: Harvard University Press.

Leedy, P. D. (1974). Practical research: Planning and design. New York: Macmillan Publishing.

Little, A. (1990). Understanding culture: A pre-condition for effective learning. United Nations Education Scientific and Cultural organization. Thailand, 5-9 March 1990.

Matsela, Z. A. (1990). An investigation of Sesotho traditional games: A preliminary study. BOLESWA Educational Research Journal. 7, 75-87

Mautle G. and Tlou J. S.(1991). Botswana. In Wickremasinghe, W. (ed.). Handbook of world education. Houston: American Collegiate Service.

McEvoy, J. (1991). Facilitating classroom based research on the teaching of number games to children with severe learning difficulties. European Journal of Special Needs Education. 6 (2), 147-153.

Millar, S. (1968). The psychology of play. Harmondsworth: Pengiun.

Mitchell, Mark & Jolley, Janina (1992). Research design explained. Fort Worth: Holt, Reinehart and Winston.

Mogasha, M. & Tsayang G. (1990). School supervision. A modern approach to working collaboratively with teachers in the improvement of instruction. A paper presented at Headteachers' supervision Workshop. Gaborone.

Mogasha, M., Tsayang, G. & LeGrand, A. (1991). Improving the teaching in primary schools. In Evans and Yonder (eds.). Patterns of reform in primary education. The case of Botswana. Gaborone: Macmillan Botswana.

Monighan-Nourot, P. et al (1987). Looking at children's play: A bridge between theory and practice. New York: Teacher College Press.

Moustakas, C (1965).The teacher and the child: Personal interaction in the classroom. Mc Graw-Hill Book.

Moustakas, C (1966). The authentic teacher: Sensitivity and awareness in the classroom. Cambridge: Howard A. Doyle.

National Institute of Development Research and Documentation (1981). Guidelines for Research. Unpublished paper

Opie P. and Opie, I. (1969). Children's games in street and playground. Oxford London: University Press.

Piaget, J. (1972). Play, dream, and imitation in childhood. London: Routledge & Kegan P

Republic of Botswana (1972). Quinquinial Report of the Ministry of Education for the years 1968-1972. Gaborone: Government Printers.

Republic of Botswana (1975). Primary Education. A different sort of thing. The first two years. Gaborone: Government Printers.

Republic of Botswana (1977a). Education for kagisanyo. Report of the National Commission on Education. Gaborone: Government Printers.

Republic of Botswana (1977b). National Policy on Education. Government Paper no. 1 of 1977. Gaborone: Government Printers.

Republic of Botswana (1985). Mathematics syllabus. The first nine years of basic education. Gaborone: Government printers.

Republic of Botswana (1988). Ministry of Education. Second biennial report 1987/1988. Education for future. Gaborone: Government Printers

Republic of Botswana (1990). Education statistics. secondary school enrollment. Gaborone: Central Statistics.

Republic of Botswana (1991). National development plan 7 (NDP). Gaborone: Government Printers.

Republic of Botswana (1979). National development plan 5 (NDP). Gaborone: Government Printers.

Republic of Botswana (1984). Botswana education in brief. Gaborone: Government Printers.

Republic of Botswana (1992). Primary school syllabuses for all subjects for standard one to Four. Gaborone: Government Printers.

Schon, D. (1983). The reflective practitioner: How professionals think in action. NY: Basic Books

Shaw et al (1991). A Cognitive Framework for Teacher Change. NAPME

Skemp, R. (1989). Mathematics in the primary school. Wocerster: Billings and Sons Ltd.:

Sleeter, C. & Grant. (1991) Empowerment through multicultural education. Albany: State University of New York Press.

Suffolk, J. A (1982). Teaching mathematics using practical methods. In Otaala B. (eds.). BOLESWA Educational Research Journal 1 (1).

Survey Research Center (1969). Interviewer's manual. Institute for Social Research. Ann Arbor: The University of Michigan.

Sutton-Smith, B. (1971). The role of play in cognitive development. In Heron & Sutton-Smith (eds.) Child's play New York: John Wiley & Sons.

Sutton-Smith, B. (1972). The folkgames of children Austin: University of Texas Press.

Taylor, Robert (1969). The arts. Cultural ways: A compact introduction to cultural anthropology. Boston: Allyn and Bacon.

Teadsdale, G.R. (1990). Interactions between 'traditional' and 'western' systems of learning. (in Little), Understanding culture: A pre-condition for effective learning United Nations Education Scientific and Cultural organization. Thailand, 5-9 March 1990.

Thomas, D. (1991). Children, teachers, and mathematics. Boston: Allyn & Bacon.

Thompson, B. (1993). Teachers interviewing teachers: You only need to ask. Curriculum 14, (1). pp. 84-90.

Thompson, I. (1994). Young children's Idiosyncratic written algorithms for addition. Educational Studies in Mathematics 26 (4). pp. 323-345

Tobias, S. (1991). Math mental health. Going beyond math anxiety. College Teacher, 39 (3), 91-93.

Tsayang, G. & Mogasha, M. (1990). An overview of clinical supervision. A paper presented at Headteachers' Conference, Gaborone

Turner, J. K. (1989). Pedagogy as an Actualization of Complementarity in Bhutan. Ph.D. Thesis. University of Alberta, Edmonton.

Ukele, B. O. (1986). School and society in Nigeria. Enugh: Dimension.

Van Hoorn, J., Nourot, P., Scales, B. & Alward, K. (1993). Play at the center of the curriculum. New York: Macmillan

Van Manen, M. (1986). The tone of teaching. Richmond: Scholastic TAB Publications

Winteridge, D. (1989). A handbook of primary mathematics co.-coordinators. London: Paul Chapman Publishing.

Yardley, A. (1971). The teacher of young children. London: Evans Brothers Limited:

Yardley, A. (1988). Discovering the physical world. Oakville: Pubicon Publishing.

Yardley, A. (1989). Structure in learning Oakville: Rubicon Publishing.

Zaslavsky, C. (1982). Tic tac toe. From ancient Egypt to modern computer and other three-in-a-row games. Toronto: Fitzhenry & Whiteside Limited.

Zaslavsky, C. (1973). Africa counts: Number and pattern in African culture. Boston: Prindle, Weber & Schmidt.

Zaslavsky, C. (1979). Preparing young children for math: A book of games. New York: Schocken Books.

APPENDIX A

Page
Questionnaire: Part 1 102
Part 2 103

A SURVEY ON THE USE OF CULTURAL/TRADITIONAL GAMES IN THE TEACHING OF MATHEMATICS

Part 1: Personal and professional background

Instructions: Please *circle* the most appropriate response or *write* a response in the space provided. Your responses will be confidential.

1. Gender
    (1). Female (2). Male
2. Age
    (1). Under 30
    (2). 30-49
    (3). 50 +

3. Highest academic qualification
    (1). Primary school Teachers' Certificate (PTC)
    (2). Advanced Teachers' Course (ATC)
    (3). Elementary Teachers' Course (ETC)
    (4). Primary Higher (PH)
    (5). Primary Lower (PL)
    (6). Others (please specify)____

4. Years of teaching experience
    (1). under 5 (4). 15 - 19
    (2). 5 - 9 (5). 20 +
    (3). 10 - 14

5. Years of teaching standard 2 or 3
    (1). under 5 (4). 15 - 19
    (2). 5 - 9 (5). 20 +
    (3). 10 - 14

6. Other information
    (1). other standard(s) you taught during your teaching profession______
    (2). number of standard 2/3 teachers in your school________
    (3). number of standard 2/3 classes in your school_________
    (4). number of teachers in your school __________________

Part 2: Use of Cultural Games in a Mathematics Lesson

Instructions: In answering questions below, mark where appropriate, or fill in the blanks provided.

HAVE THE FOLLOWING DEFINITIONS IN MIND WHEN ANSWERING THIS SECTION.

A Game is any contest/competition (setting) among players interacting within a set of limitations/rules to achieve a goal.

An educational Game is an activity which may simulate a real situation, and it aims to teach skills or ideas of some sort, content, and/or attitudes. It may be relevant for use in different subjects.

Commercial Games are those which are published and are sold in the bookstores and other shops, e.g. snakes and ladders.

Cultural/ Traditional Games are games derived from the history of the society. They are not commercial. These include play song, sand and stone games, string games etc. The children get involved in these games at home, before and during their school years, for example, rope skipping (koi), hole and pebbles (diketo, morabaraba).

Culture reflects the experiences, the behaviors, norms and values of a group of people. It is subject to gradual but continuous modification by succeeding generations.

A Games and the curriculum

I. Which of the following do you use? (You may mark more than one response.)
 (1) a commercially published educational game (e.g.. snakes and ladders, dice rolling etc.)
 (2) a commercially published game which you have modified
 (3) a game you have developed
 (4) a game developed by a colleague
 (5) a cultural/traditional game you have modified
 (6) a cultural/traditional game developed by your colleague
 (7) a cultural/traditional game suggested and/or developed by your students
 (8) none of the above

II. Of the games that you have marked in (1) above, which ones do you use in teaching the following subjects;
 (1) Social studies ____________________
 (2) Setswana ____________________
 (3) Science ____________________
 (4) Religious studies ____________________
 (5) Agriculture ______________
 (6) English ____________________
 (7) Art ____________________
 (8) others ____________________

B Games and Mathematics Teaching

I. Indicate your agreement or disagreement to the following statements with regard to the **usefulness** of using cultural/traditional games in the teaching of mathematics, by selecting one of the following indicators: **Strongly Disagree (SD), Disagree (D), Not Sure (NS.), Agree (A), and Strongly Agree (S.A.)**.

	SD.	D.	N. S.	A.	S.A.
(1) Students are motivated through games	[ ]	[ ]	[ ]	[ ]	[ ]
(2) Games help students to understand concepts more easily	[ ]	[ ]	[ ]	[ ]	[ ]
(3).Games help students develop and use problem solving techniques	[ ]	[ ]	[ ]	[ ]	[ ]
(4) Games encourage competition among students	[ ]	[ ]	[ ]	[ ]	[ ]
(5) Games develop pattern recognition skills	[ ]	[ ]	[ ]	[ ]	[ ]
(6) Games do not develop systematic planning	[ ]	[ ]	[ ]	[ ]	[ ]
(7) Games enable students to relate mathematics to their 'real world'	[ ]	[ ]	[ ]	[ ]	[ ]
(8) Through games students participate in their learning	[ ]	[ ]	[ ]	[ ]	[ ]
(9) Games develop critical thinking	[ ]	[ ]	[ ]	[ ]	[ ]
(10) Games develop decision making abilities	[ ]	[ ]	[ ]	[ ]	[ ]
(11) Teaching materials (for games) are easily accessible	[ ]	[ ]	[ ]	[ ]	[ ]
(12) Skill-practice games help students learn the basics easily	[ ]	[ ]	[ ]	[ ]	[ ]
(13) Gaming activities are difficult to evaluate	[ ]	[ ]	[ ]	[ ]	[ ]
(14) Some students don't like to play games	[ ]	[ ]	[ ]	[ ]	[ ]
(15) Games enhance teaching with understanding	[ ]	[ ]	[ ]	[ ]	[ ]
(16) Teachers know their students better through games	[ ]	[ ]	[ ]	[ ]	[ ]
(17) Games improve achievement scores	[ ]	[ ]	[ ]	[ ]	[ ]
(18) Games take too much of class time	[ ]	[ ]	[ ]	[ ]	[ ]
((19 Students don't take games seriously	[ ]	[ ]	[ ]	[ ]	[ ]
(20) Games provide immediate feedback	[ ]	[ ]	[ ]	[ ]	[ ]
(21) No serious work can be done when games are used in the classroom	[ ]	[ ]	[ ]	[ ]	[ ]
(22) Games foster curiosity, CO-operation, and positive attitudes towards mathematics	[ ]	[ ]	[ ]	[ ]	[ ]
(23) Students are bored when games are used	[ ]	[ ]	[ ]	[ ]	[ ]
(24) Cultural games are not related to school work	[ ]	[ ]	[ ]	[ ]	[ ]
(25) Games allow child-centered approach	[ ]	[ ]	[ ]	[ ]	[ ]

II. Below is the list of games that boys and girls in Botswana get involved in. Indicate the extent to which you use each game in the teaching of mathematics by selecting one of the following: **Very often, Often, Rarely, Very Rarely**

	GAME	Very often	Often	Rarely	Very Rarely
(1)	Diketo	☐	☐	☐	☐
(2)	Koi	☐	☐	☐	☐
(3)	Khupelekhupele	☐	☐	☐	☐
(4)	Tshetshe	☐	☐	☐	☐
(5)	Sekotshe	☐	☐	☐	☐
(6)	Morabaraba	☐	☐	☐	☐
(7)	Tonki	☐	☐	☐	☐
(8)	Terena	☐	☐	☐	☐
(9)	Nonyane tse tlhano	☐	☐	☐	☐
(10)	Banyana banyana	☐	☐	☐	☐
(11)	Foranse skipping	☐	☐	☐	☐
(12)	Nna ke ka go kitla	☐	☐	☐	☐
(13)	Dibeke (bottle, stone, etc.)	☐	☐	☐	☐
(14)	Mhele	☐	☐	☐	☐
(15)	Lotshitshi la noka	☐	☐	☐	☐
(16)	Peba le katse	☐	☐	☐	☐
(17)	Ntshala Morago	☐	☐	☐	☐
(18)	Tshwara molekane	☐	☐	☐	☐
(19)	Nxai	☐	☐	☐	☐
(20)	______________	☐	☐	☐	☐
______		☐	☐	☐	☐
______		☐	☐	☐	☐
______		☐	☐	☐	☐
______		☐	☐	☐	☐

(Use an extra page if you wish)

III. Below is the list of games that you might have used in mathematics teaching. Indicate topics in which you integrated the game, and the reasons for using the game. For example,

Name of the game: ______ e.g. *diketo* ______
Topic in which the game was incorporated: e.g. *addition /subtraction of numbers*
Reasons for using the game: ______ e.g. *lesson introduction*

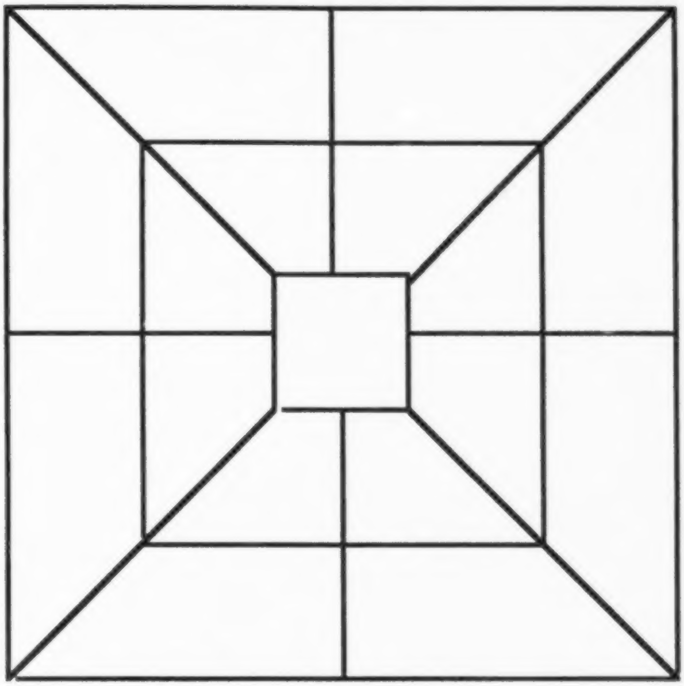
GAME	TOPIC(S)	REASONS
1). Diketo		
2). Koi		
3). Khupelekhupele		
4).Tshetshe		
5).Sekotshe		
6). Morabaraba		
7). Tonki		
8). Terena		
9). Nonyane tse tlhano		
10). Banyana banyana		
11). Foranse Skipping		
12). Nna ke ka go kitla		

13). Dibeke (bottle, stone, (etc.)		
14). Mhele		
15. Lotshitshi la noka		
16). Peba le katse		
17). Ntshala morago		
18). Tshwara molekane		
19). Nxai		
20).		

(Use an extra page if this page is full)

Please Turn over

IV. Below is 'mhele' diagram.



'MHELE' BOARD

1) What mathematical concepts or ideas (from the curriculum) do you see displayed in the diagram?

2) What skills can be learned from playing 'mhele' game?

3) How can you modify the game to suit the teaching and learning process in your situation.

THANK YOU VERY MUCH FOR YOUR PARTICIPATION.

APPENDIX B

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University of Alberta
Edmonton

Canada T6G 2G5

Department of Secondary Education
Faculty of Education

341 Education South, Telephone (403) 492-3674
Fax: (403) 492-9402 Email: SE04@MTS.UCS.UALBERTA.CA

28 th May, 1993

Permanent Secretary to the President
Office of the President
Private Bag 001
Gaborone

Dear Sir,

Re: Application to conduct research on primary school teachers (Central District)

I hereby applying for the permission to conduct a study with primary school teachers who are currently teaching grades two and three, in Central District. The study is on the use of cultural games and activities in a mathematics class. The study is part of the requirement for my Master of Education degree at the University of Alberta.

The tentative date to conduct this study is Mid-October 1993 to early 1994. I have no doubt that the study will be beneficial to the educational system, and to the country at large.

Enclosed is the research proposal, my supervisor's letter (copy), Dr. Kieren and the research application form.

I would like to hear from you as soon as possible so that I may plan for the study in good time.

Thanking you in anticipation.

Yours Faithfully,

KGarekwe.

Kgomotso G. Garekwe (Mrs.)

Office of the President
Private Bag 001
GABORONE

REF. NO: OP 46/1 XXXIX (70)

18/8 93
..........19....

TO: Mrs. Kgomotso Garekwe
University of Alberta
341 Education South
Canada

Dear S~~ir~~/Madam,

ANTHROPOLOGICAL RESEARCH ACT
GRANT OF PERMIT UNDER SECTION 3

I refer to your letter dated 31st May 1993 about application to do research.

In exercise of the powers vested in him by the Anthropological research act the Minister of Presidential Affairs and Public Administration has granted permission to Kgomotso G. Garekwe to carry out research on the Cultural Games and Activities in a mathematics class: The case of Botswana

The research will be carried out for a period not exceeding Five (5) months, with effect from 15th October 1993 and will be carried out at Central District

This permit is granted subjective to the condition that any papers written as a result of the research shall be deposited with Government Archivist, Director - National Library Service.

Yours faithfully,

K. Lebanna
for/PERMANENT SECRETARY TO THE PRESIDENT

c.c. District Commissioner Serowe
Director, Library Service
Government Archivist
Director, N.I.R.

Department of Secondary Education
341 Education South
University of Alberta
Edmonton, Alberta
Canada, T6G 2G5

The Principal

January, 1994.

____
____
____
____

Dear Sir/Madam,

I am a graduate student at the University of Alberta, Canada. As part of my program I am undertaking a survey on the use of cultural/traditional games in mathematics teaching. The results of this study may help mathematics teachers in the country, especially those at primary schools and make the learning of the subject relevant to learners' experiences.

The co-participants in the study are teachers who were teaching standards two and three in the Central District Primary Schools, during the previous year (1993). Your school has been chosen through random sampling procedure to participate in the survey. I therefore, kindly ask you to forward these two questionnaires to two of your staff members (standard 2 and 3 teachers). Please remind your teachers that they are free to opt if they are not interested in the study; that their responses and names will be confidential. Your cooperation is appreciated.

Please, find enclosed copy of the permission letter to carry out the study from The Office of the President, Gaborone.

Thanking you in advance.

Yours Sincerely,

Kgomotso G. **Garekwe**

Department of Secondary Education
341 Education South
University of Alberta
Edmonton, Alberta
Canada, T6G 2G5

January, 1994.

Teacher (std 2/3)

____
____
____

Dear Colleague

I have been away from the country for about 12 months, pursuing a graduate degree in the Department of Secondary Education in University of Alberta, Canada. I am interested in making mathematics relevant to the needs and experiences of the learners. As a result, I am pursuing a survey on the use of cultural/traditional games in the teaching and learning of mathematics especially at lower classes. The study is part of my program at the University of Alberta. The co-participants are teachers who were teaching standards two and three in the Central District Primary Schools, during the previous year (1993). Therefore, your school has been selected to participate in the study, and your head teacher has nominated you to represent the school. I therefore, kindly invite you to participate in the study by answering the enclosed survey. The survey would take less than 20 minutes to complete. I assure you that all the information will remain confidential and will be used for the study only. If you want the summary of the findings sent to you, please send me your name and address in a separate envelope.

A stamped self-addressed envelope is enclosed so that you may return the survey as soon as possible. I will appreciate it if you can send in your survey questionnaire by February 1st, 1994. Should you have any questions regarding the survey, please feel free to contact me at this phone number: 351151- extension 271- University of Botswana, Private Bag 0022, Gaborone.

Your participation will make a major contribution to the field of Mathematics Education in Botswana schools. Thank you very much for your participation in the study. Please be advised that if you are no longer interested in the study you are free to decline. Your responses and names will be treated confidential.

Yours Sincerely,

Kgomotso G. **Garekwe.**

Department of Secondary Education
341 Education South
University of Alberta
Edmonton, Alberta
Canada, T6G 2G5
1st, February, 1994.

The Headmaster
____
____
____

Dear Sir/Madam,

This letter serves to inform you that I **have not yet received** two survey forms which I did send to your school on January, 10 th. Please do remind your 2 teachers (for std. 2 and 3), to send those questionnaires, and should reach me by **14 th February.** I will be leaving the country during that week, and would very much appreciate **to include responses from your school in the data analysis** which is to be done in Canada. Please, be reminded that this is a vital study to the country's curriculum development process. Information from your teachers **will, indeed, make a unique contribution to this endeavor.**

Thanking you in advance, for making such an astounding contribution towards the innovation of Primary School Mathematics Curriculum, by advising your teachers to return the survey. If your teachers have already mailed the survey, please ignore the letter.

Yours Sincerely,

Kgomotso G. **Garekwe**

APPENDIX C

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Worksheet Three.......... 119

Demonstration Lesson
Standard 3 Class

Multiplication and Division of Numbers Using Diketo Game

Lesson Goal
The goal of the lesson is to use 'diketo' to teach multiplication and division of whole numbers.

Objectives of the Lesson.
At the end of this lesson learners will be able to
1. use repetitive addition to multiply positive numbers
2. use repetitive subtraction to divide positive numbers (non-fractional quotients)
3. relate the skills learned in diketo to multiply and divide numbers

DOUBLE LESSON (80 minutes)

Parts of the lesson	Detailed Description of lesson activities	Time allocation
Introduction		
-demo on recording the worksheet	-the demonstrates how to fill the worksheet	3 minutes
	-students get into groups	
-playing	-Students will be grouped in pairs to play diketo game	2 minutes
	-they will be recording the steps they are taking in the table provided (columns 2 and 3)	10 min.
Development		
-repetitive addition	-Teacher lead discussions to fill columns 3, 4 and 5 (of the worksheet)	
-repetitive subtraction	-questions to discuss on the concepts of multiplication and division	
-extension	-using other numbers other than 10, e.g. 15 pebbles, 20 pebbles in the discussion	35 mins
Summary		
-tying together the concept multiplication and division	-students will fill in a table of multiplication and division. This will be done in groups	5 mins
	-teacher attends individual problems	
	-more exercise (application problems)	10 min.
Conclusion	-a home work will be given	2 mins

WORKSHEET ONE

Playing Diketo Game

As you play, fill in the table below by recording the number of times you have placed back pebbles inside the whole. The first is done for you.

Groups of 1s, 2s, 3s, etc.	Number of repetitions (the number of times you have returned pebbles into the hole	Adding up to the total sum (=10)	How many 1s, 2s, 3s, etc. are there in 10?	Summary
1	10	1+1+1+1+1+1+1+1+1+1=10		
2				
3				
4				
5				
6				
7				
8				
9				
10				

How many groups of 2s can we get from 10? A practical question.
(Allow learners to literally take out (and count) the groups of two out of 10).

____

How may groups of 5 can we get from 10? ______________________

WORKSHEET 2

SUMMARY OF THE LESSON

Get your partner to fill the following table.

Multiplication	Division
1 × __10__ + __0__ = 10	10 ÷ 1 = 10 remainder 0
2 × ____ + ____ = 10	10 ÷ ___ = 2 remainder 0
3 × ____ + ____ = 10	___ ÷ ____ = 3 remainder 1
4 × ____+ ____ = 10	10 ÷ ___ = ___ remainder 2
5 × ___ + ____ = 10	10 ÷ 5 = ___ remainder
6 × ____ + ____ = 10	10 ÷ __ = 1 remainder 4
7 × ____+ ____ = 10	___ ÷ 7 = 1 remainder
8 × ____+ ____ = 10	10 ÷ __ = __ remainder
9 × ___ + ____ = 10	__ ÷ 9 = __ remainder 1
10 × + = 10	10 ÷ 10 = ___ remainder

WORKSHEET 3

Home Work

How many groups of 2s, 3s, 5s, 10s, and 15s are in 8, 13 and 20? Use the table below to answer this question. (You may play diketo with 8, 13 and 20 pebbles respectively).

Numbers in question	Groups of 2s	Groups of 3s	Groups of 5s	Groups of 10s	Groups of 15s
8					
13					
20					

APPENDIX D

MATHEMATICAL CONCEPTS IN SOME OF THE TRADITIONAL GAMES

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Diketo.. 123

Khupelekhupele.. 125

Morabaraba.. 125

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1. DIBEKE

Number of players: At least four

Facilities: Enough space for a group of children to play, ball (tennis ball or one made out of rags), bottle, enough sand, stone.

Age: Six years and up

This game has three versions: bottle counting, stone counting, and four-base movement. The first two versions are mostly played now, and the third one is almost forgotten. The game is mostly played by girls.

Bottle Counting. Two members of the fielding group throw the ball between each other. A member of the playing group is between these two people, and the aim is to hit or touch her with the ball. She dodges the ball as she tries to fill the bottle with sand. If the bottle is filled, the player starts counting up to the agreed number; for example, if it is 100, immediately after filling the bottle with sand she counts 1, 2, 3, ... 100 as quickly as possible. After counting, the bottle is emptied, the group belonging to the player gets a point, and they start playing again.

The player has to fill the bottle and count before she is touched by the ball. If she is touched, another player from her group continues where she left off. This continues until all the members of the group are touched. Then it is the fielding group's chance to play.

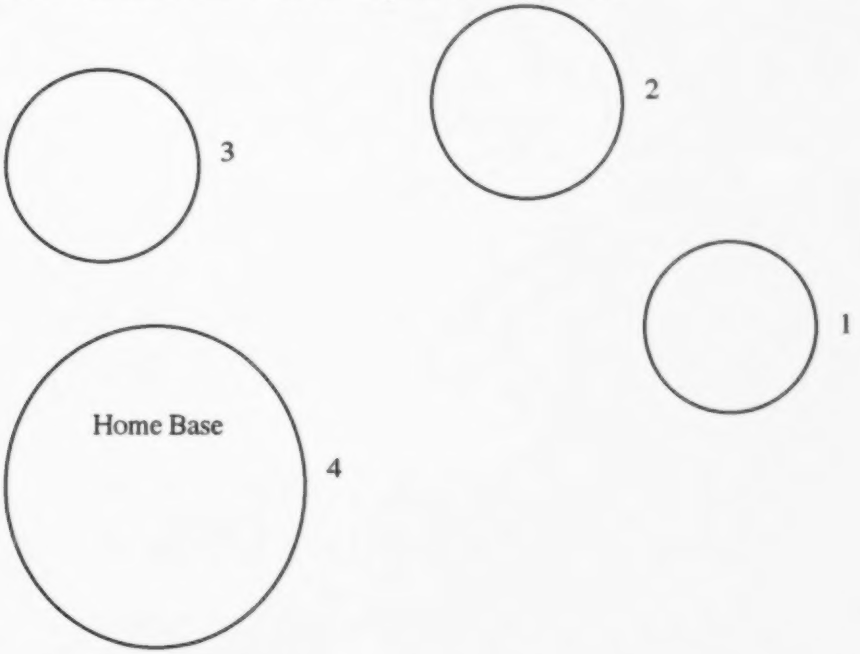
The points are counted according to the number of bottles filled. The winning group therefore has the most bottles filled by its members.

Stone Counting. In this version the player puts her foot on top of the stone at the center of the fielders while counting. The player starts to count to a certain number which is agreed upon by the two parties. For small children the number is small; for instance, 10 or 20; for older children the number is big, for example, 50, 100, or 200.

When the player is touched by the ball, the group member coming in to replace her should start counting where she has left off. For example, if she was touched when she mentioned 57, the coming girl should shout 57, 58, etc. The counting is done only when the foot is on top of the stone.

The members of the opposing group try by all means to disrupt the counting so that the player forgets the sequence of numbers. If the player says a wrong number she is out. For example, if the player says 52 instead of 42 she is out, and another girl from her group comes in and starts counting from the beginning; that is, from 1.

4-Based Dibeke. Four circles are drawn as shown below; home base and three other circles. The home base is the starting and finishing circle.



The two groups have to agree upon the number which will be used. For example, if 5 is chosen it would mean that the winning number is 20. The player in the first base will score 5, in the second base 10, in the third base 15. When they reach the fourth base the score is 20 and they have a point.

Like the two versions there is a player in between the two fielders. As she dodges the ball the members of her group try to move from the zero position to the first, second, third, and fourth positions. If the ball goes far enough she joins her group members to run around.

The responsibility of the fielding group is to touch each member of the playing group with a ball when they are not inside any circle. If all members are touched the group fields, giving their opponents a chance to play.

Mathematics in Dibeke

Probability (chances of the group to win or lose depends on the number of its members)
Volume in bottle-filling version
Arithmetic in stone and bottle-counting version
Problem-solving strategies
Multiples of four in 4-based version

2. DIKETO

Number of players: One and up

Facilities: Enough space to accommodate players, at least 11 small round pebbles

Age: Five years of age and up

A hole 5 cm deep and 10 cm wide is dug in the ground. Ten pebbles are put inside the hole. To play the game, these pebbles are removed from the hole, then put back one by one. After finishing they are removed again; this time they are put back in twos; removed again, and put back in threes, that is, 3 + 3+ 3 + 1. The procedure is repeated until the pebbles are put back into the hole all at once. Each time the player removes the pebbles from the hole she throws the eleventh one into the air, and then catches it before it falls down. Each time she puts the pebbles back into the hole she throws the eleventh pebble into the air and then catches it before it falls.

This is how it goes: Throw the pebble into the air, while in the air remove the 10 pebbles from the hole, and catch the pebble in the air before it falls. Throw it again, put one pebble back into the hole catch the pebble in the air, throw it again, put another pebble back into the hole, catch the rolling pebble, and so forth. After putting all pebbles back into the hole, remove them again following the previous procedure. Return the pebbles this time in twos. After this, return them in threes, fours, fives, and so forth. Now when returning all the pebbles at once, do it twice and you will have scored. Scores are multiples of 10.

If the player misses the pebble in the air, or instead of returning four pebbles she returns three she has gone wrong. If she plays alone, she must go over what she has missed and then continue with the game. If playing with other children, then it is a chance for one of them to play. Each player should have her pebble to play with. Sometimes two or three pebbles are thrown into the air.

Mathematics in Diketo

a) Subtraction and Addition: As the player is putting the pebbles back into the hole, she is adding pebbles to the ones already in the hole and subtracting from the ones outside the hole.

b) Multiplication and Division: As she put pebbles back in twos, she is dividing 10 by 2. She throws the eleventh pebble five times, and if we take this number and multiply it by the number of pebbles she is putting back at a time, we get 5 X 2, which is 10.

-Multiples of 10

3. KHUPELEKHUPELE

Number of players: At least two

Facilities: Sand or hands

Age: Four years and up

Children can use their hands or sand to play this game. A game is played by both sexes.

Hands. A player hides an object in one of his or her hands and ask the opponent to guess which hand has the object. If the opponent guesses right she or he has a point, and it is time for him or her to play.

Heap of Sand. A player makes as many heaps of sand as he or she wishes. An object is put in one of the heaps. The duty of the opponent is to guess which one has the object.

Mathematics in Khupelekhupele

Probability: In the case of hands the opponent has 1 out of 2 chances to guess right; in the case of heaps of sand the chance for opponents to guess rightly is 1 out of the number of heaps of sand.

4. MORABARABA

Number of players: At least two

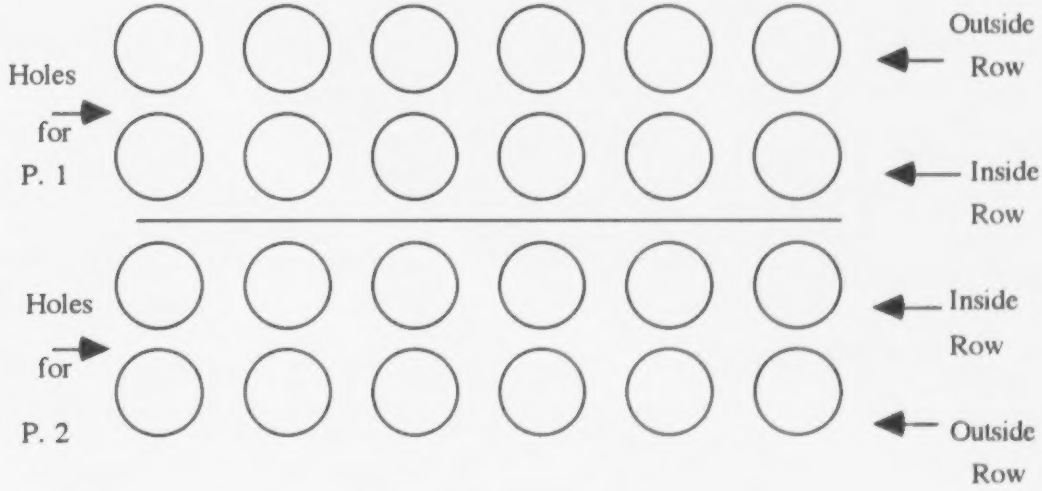
Facilities: Enough space to scoop the 24 holes, 48 pebbles

Age: Five years and up

Twenty-four shallow holes are scooped out of the ground. Twelve holes belong to each player. Each player has 24 pebbles to play with. To start the game each hole contains two pebbles. The first player takes his or pebbles and puts one into a hole at a time in a counter-clockwise direction. If the last pebble falls onto other pebbles, all pebbles are taken and each is dropped into each hole. If the pebble falls into an empty hole facing the opponent's side (that is, the inside row), the player confiscates the opponent's pebbles on the two holes opposite that empty hole. If the hole is on the player's side (that is, the outside row), he or she stops playing and another has a chance to play. The winner is the one who collects the most pebbles.

The game may be played with a total of 24 pebbles. In this case each player will have 12 pebbles with which to play. To start the game there should be one pebble per hole. The rules are the same as above.

There is another version where the main objective is to collect pebbles into one hole regarded as the kraal for cattle (moraka). In this version the aim is to drop the last pebble into the selected hole. While transferring the pebbles, one has to count the pebbles in the holes carefully, and try to get as many pebbles as possible from the opponent's side.



NB. P. 1 = player one, P. 2 = player two

Mathematics in Morabaraba

Counting (one-to-one correspondence)

Addition and subtraction

Multiples of two

Coordinates (transferring points-pebbles)

Directed numbers (clockwise and counter-clockwise direction)

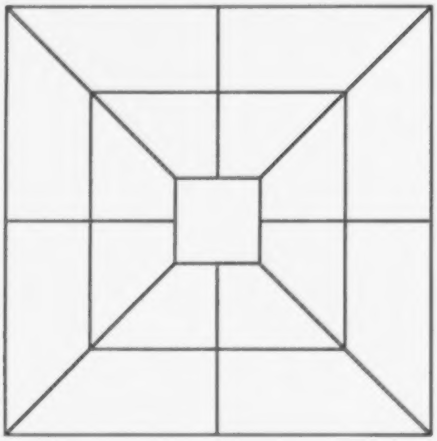
5. MHELE

Number of players: At least two

Facilities: A piece of cardboard or enough ground space to draw the diagram, 24 pebbles

Age: Five years and up

The game is mostly played by males. Females enjoy the game too, especially at a younger age. The game is played on a board with 24 position (intersections). The diagram can be drawn on the ground.



There are two steps involved in playing the game: placement and movement. Each player must have 12 pebbles which should be identifiable from those of the opponent's.

Placement. The first player puts his stone on any intersection. The opponent puts a stone on an intersection not occupied. They continue in turns to put their pebbles on the intersections. The aim is to form a line of three stones (called mhele) in any direction (horizontally, vertically, or diagonally). The first player to do this captures one of the opponent's stones. Therefore, players should not heedlessly place their stones; they have to think and try to hinder the opponent from forming a line of three. (It is important that during placement at least one stone is captured so that there is room for movement.)

Movement. After placing all the pebbles on the board, they are moved to free intersections. The player should not skip any intersection next to the stone being moved. This movement also aims at forming a line of three, after which the player captures one of the opponent's stones. This continues until one player is left with only three stones. This player is now entitled to skip (jump) intersections in an attempt to try to stop the opponent from forming a row of three. If he is left with two stones he is the loser, and that marks the end of the game.

Mathematics in Mhele

Counting and multiples of three

Geometry

Problem-solving strategies

Enlargement- the diagram is an example of an enlarged figure.

6. TSHETSHE

Number of players: One and up

Facilities: Enough space to draw 10 circles, at least one pebble

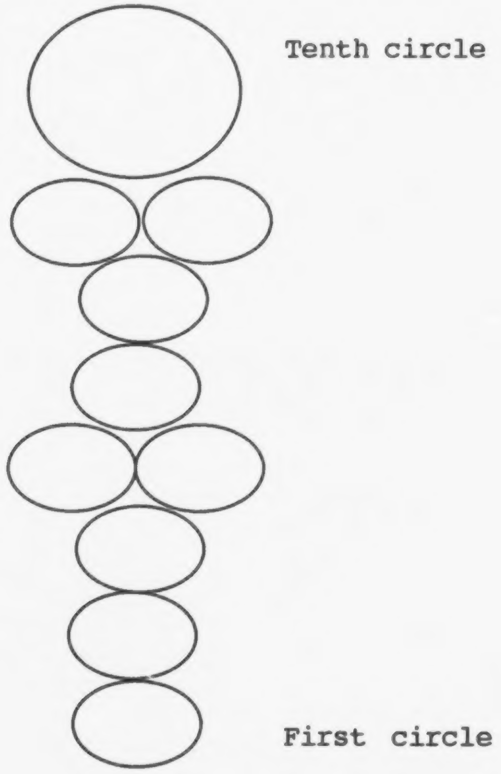
Age: Five years of age and up

As shown on the next page, 10 circles are drawn as shown in the next page. In this game, the player jumps from one circle to another on one leg. The stone or pebble is used to play the game.

A pebble is thrown inside the first circle. The player then jumps with one leg into the second and the third circles and then jumps into the two parallel circles with two legs. She then jumps into the sixth and the seventh circles with one leg, then the two parallel circles with two legs. Then she jumps into the tenth circle. She comes back following the same procedure (that is, jumping into circles 9 & 8, 7, 6, 5 &4, 3, 2, 1) and after picking up the pebble, she jumps outside the circles. During the second turn the stone is thrown into the second circle. She then follows the same procedure as before and does not jump into the circle where the pebble is. Note that the pebble is thrown only into the vertical circles, that is, circles 1, 2, 3, 6, 7 and 10.

After throwing the pebble into the last circle, the player then becomes a blind person and walks inside the vertical circles each time saying "in" whenever she steps into the vertical circles, and "open" whenever she put her legs inside the parallel circles.

In another version, after throwing the pebble into the last circle, the player comes to the first circle, faces the opposite side, then throws the stone over her shoulder. Where the stone falls is the position of her game point. As the game continues no one uses this circle except the owner of the stone. It is her resting place.



Mathematics in Tshetshe

Probability

Arithmetic

Estimation

All these games can be modified by changing either the rules or the diagrams to suit different learning and teaching situations. It is also important to note that other versions of some of these games have not been discussed.